

INTERVENTIONAL RADIOLOGY

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УНИВЕРЗИТЕТ
У КРАГУЈЕВЦУ



Objectives

- ▶ Interventional non-vascular radiology, modalities and techniques,
- ▶ Percutaneous biopsies,
- ▶ Percutaneous drainage

Interventional radiology (IR)

*interventional procedures performed
inside the body using percutaneous
(puncture through the skin)
techniques under imaging guidance*

Why IR procedure?

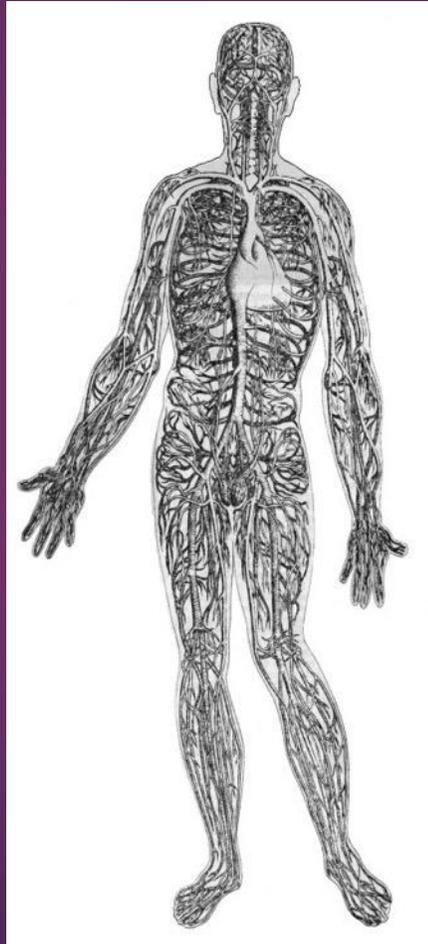
- minimal invasive treatment of disease or symptoms
- short recovery time
- results superior/compatible to other methods
- fewer complications
- new treatment methods
- possibility of repeated treatment

IR knowledge – anatomy (e.g.):

Arteries



Veins

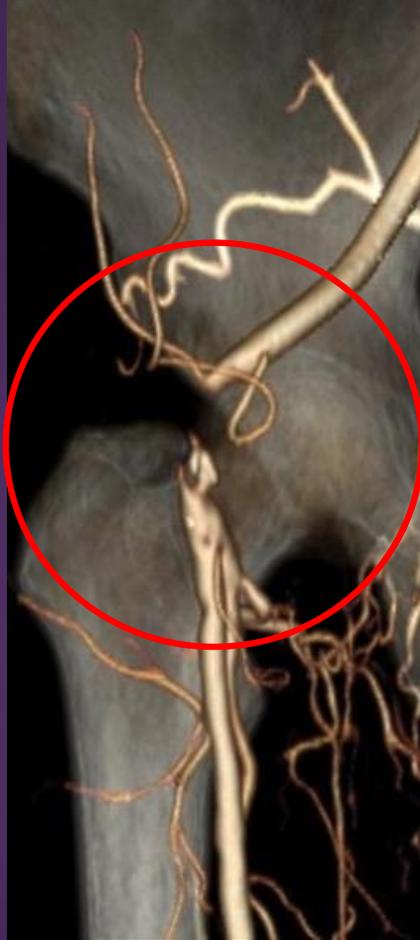


Bile ducts



IR knowledge – pathology (*disease*)

Arteries



Veins

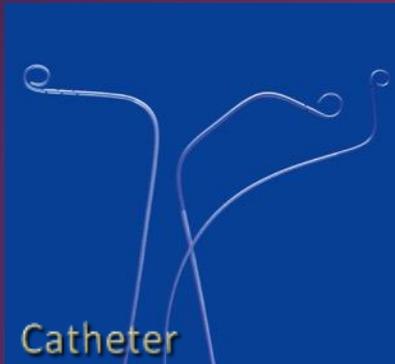


Bile ducts



IR knowledge

Materials



Catheter



Stent

Methods



How to do it



IR procedure

Puncture with a needle through the skin of (e.g.):

- vessel (vein or artery)
- bile duct
- kidney
- fluid collection

Procedures are done through the puncture channel

GOAL

- ▶ To simplify treatment in a way that minimizes patient discomfort, renders general anesthesia unnecessary, lowers the incidence of morbidity and mortality, and decreases the length and cost of hospitalization.
- ▶ • Special procedures can replace surgery (embolization of bleeding ulcers).
- ▶ • Others can complement surgery (postoperative abscess drainage).
- ▶ • Certain procedures can be used in the management of conditions for which there is no surgical solution (selective chemotherapy).

IR procedures

- ▶ VASCULAR
- ▶ NON-VASCULAR

NON-VASCULAR IR PROCEDURES

includes diagnostic and treatment of benign conditions and cancer (when it is known as interventional oncology). They are used for the following:

- ▶ biopsies
- ▶ to treat tumours/cancer, such as tumour ablation, embolisation, chemoembolisation and radioembolisation (SIRT)
- ▶ to relieve the effects of the cancer on other systems, eg blockage of the oesophagus, bowel, kidney (nephrostomy) or liver (biliary drainage)
- ▶ to drain collections of fluid or pus in the chest or abdomen
- ▶ to treat collapsed spinal bones (vertebroplasty)

Image Guided Drains

- ▶ Using ultrasound or CT guidance we can insert a needle into fluid collections or abscesses anywhere in the body and insert a drain over a wire to remove the fluid or abscess. The CT images show a drain being inserted into an abscess in the pelvis. Patients for this procedure can be referred to us by any medical or surgical specialty. It is usually performed under local anaesthetic. Most patients requiring abscess drainage are quite poorly and need post procedure care on a ward for close observation and monitoring.



Drainage tube placement

To drain out e.g. infected fluid collections

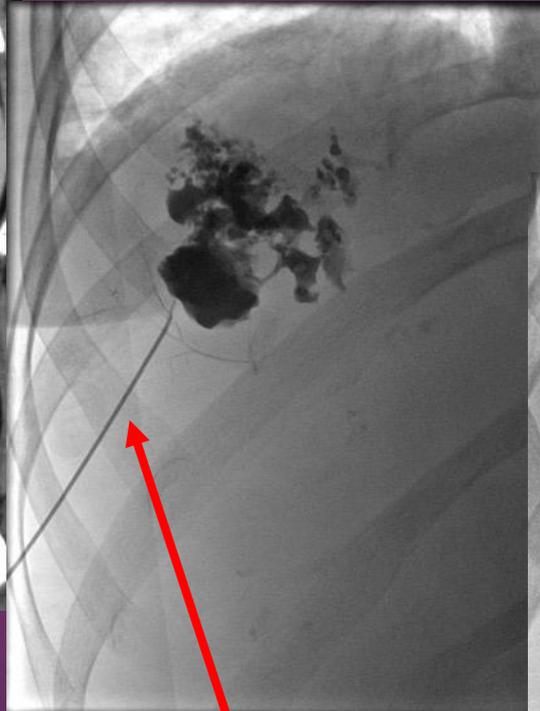
To take out fluid for examination

To create communication between two cavities in the body

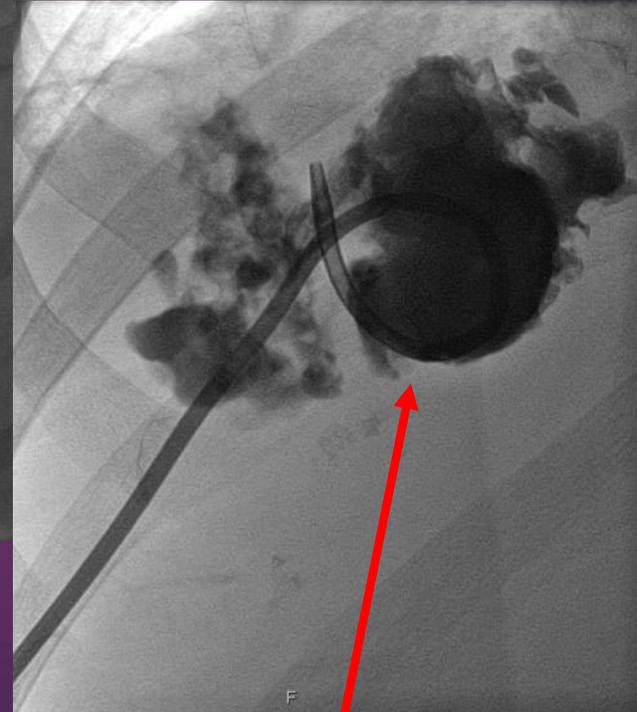
Drainage



Pus collection in the liver



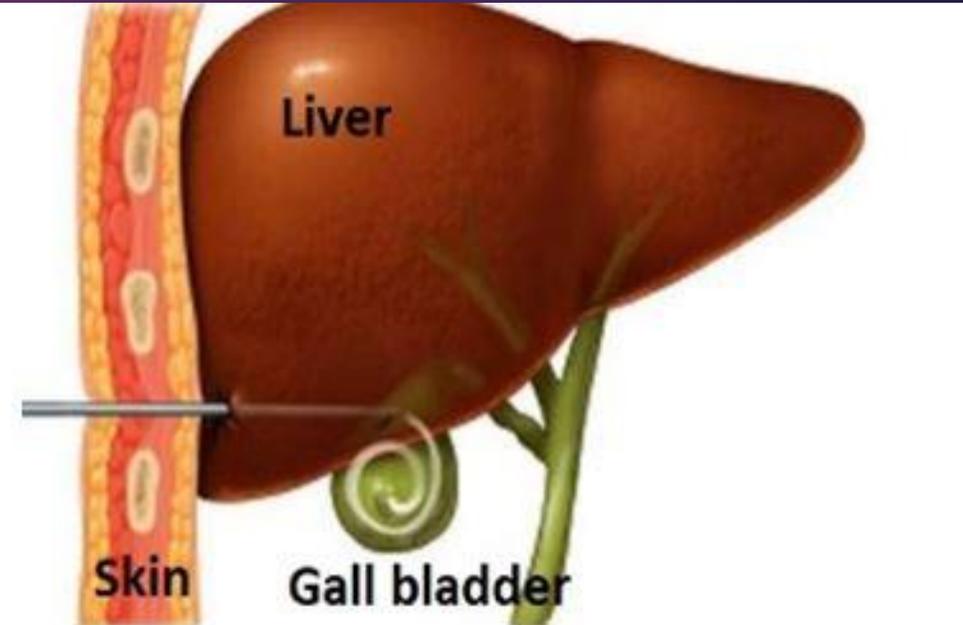
Puncture with a needle



Draining tube in place

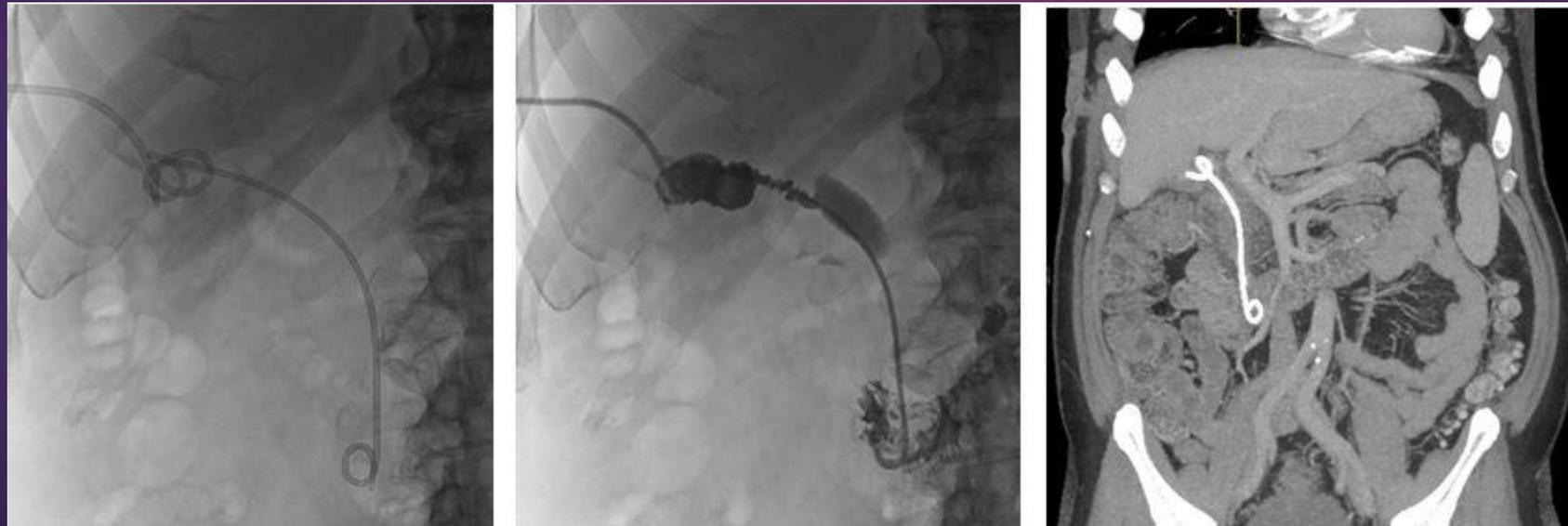
Cholecystostomy

If the gall bladder becomes blocked with stones or tumour it can make patients very unwell and lead to septicaemia. We use ultrasound or CT to guide a needle through the skin and liver into the gall bladder. We then insert a tube over a wire to allow the gall bladder to drain. This procedure is usually performed under local anaesthetic. Most patients requiring cholecystostomy are quite poorly and need post procedure care on a ward or ITU for close observation and monitoring.



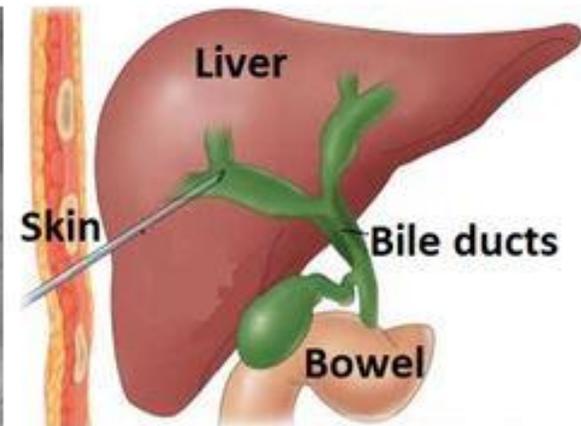
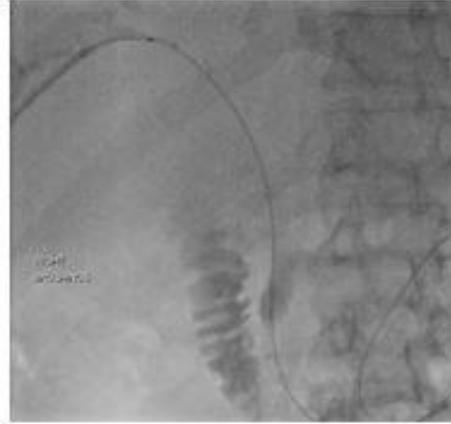
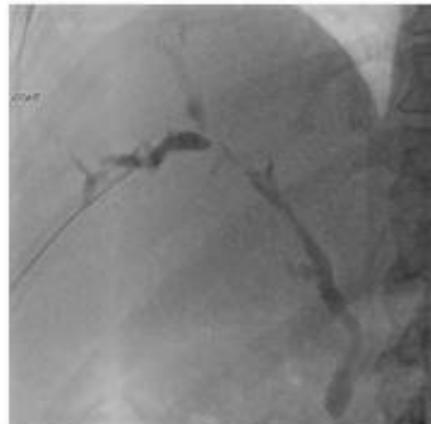
Cholecysto-duodenal Stenting

- ▶ If someone suffers with gallstones, they usually have their gall bladder removed surgically. If they are not fit for surgery, they may be left with a drain in their gall bladder (cholecystostomy) for the rest of their life to prevent gall bladder infections. For these patients it's sometimes possible to place a drain between the gall bladder and the bowel to reduce the risk of further blockages.



Percutaneous Transhepatic Cholangiogram (PTC)

- ▶ If the liver becomes blocked by stones or tumours we insert a needle through the skin into a tiny duct in the liver using ultrasound to guide us. Once inside we use x-rays to guide a wire through the liver into the bowel and insert a stent between the liver and bowel to bypass the blockage. Patients for this procedure are usually referred to us by our gastroenterology, oncology or hepatobiliary colleagues. It is performed under local anaesthetic and sedation as it can be a challenging procedure.



Interventions in the bile ducts

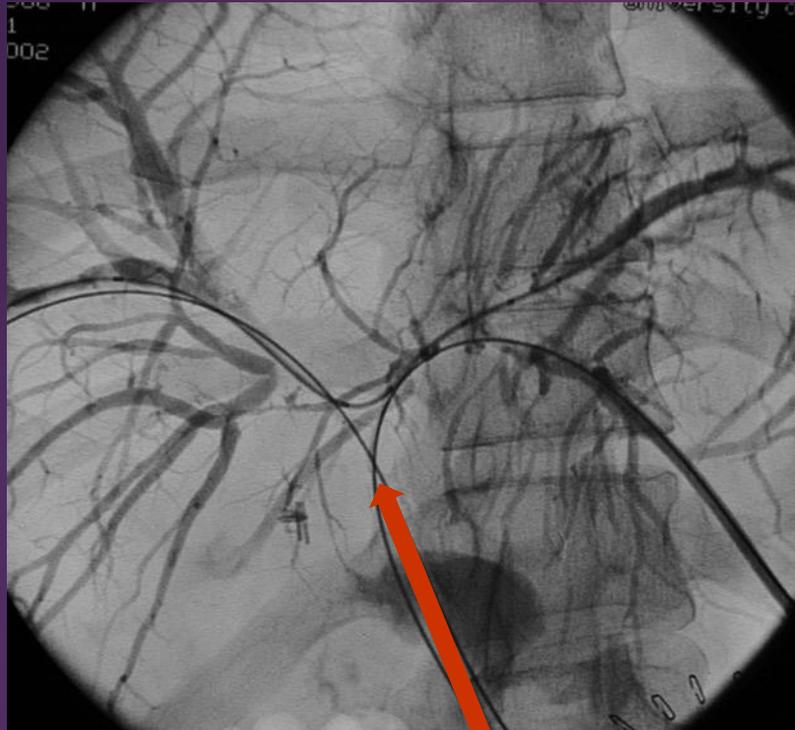
Occlusive disease (stop in bile duct)

- stone removal
- drainage through the catheter (*tube*)
- recanalization (opening of the close bile duct)
- stent placement

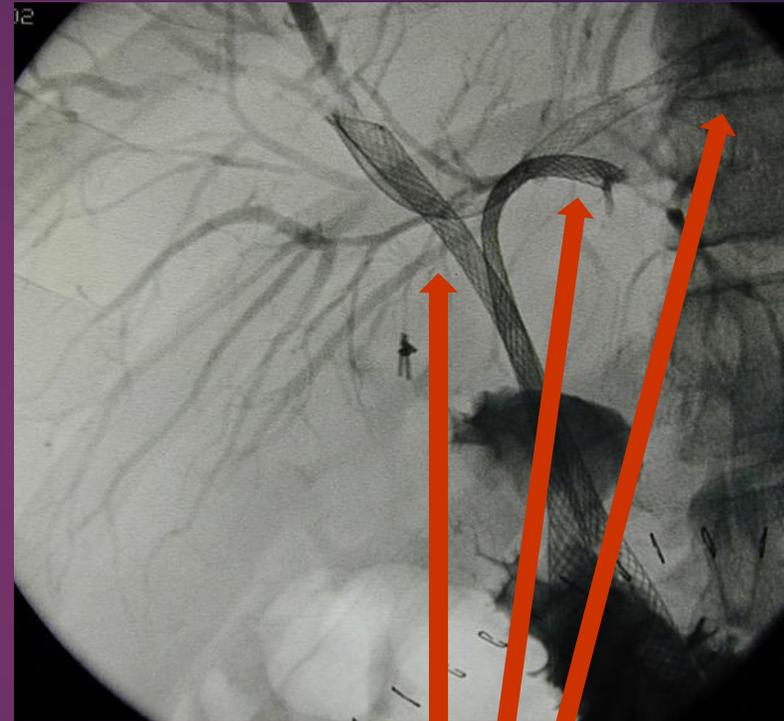
Gallbladder

- drainage catheter placement (to drain out infected bile)

Bile duct opening with stent



Bile ducts closed by tumor



Bile ducts reopen with the multiple stents

Bile duct stone removal



Big stone in bile duct



Big stone in the basket



Stone crushed

IR in liver cirrhosis

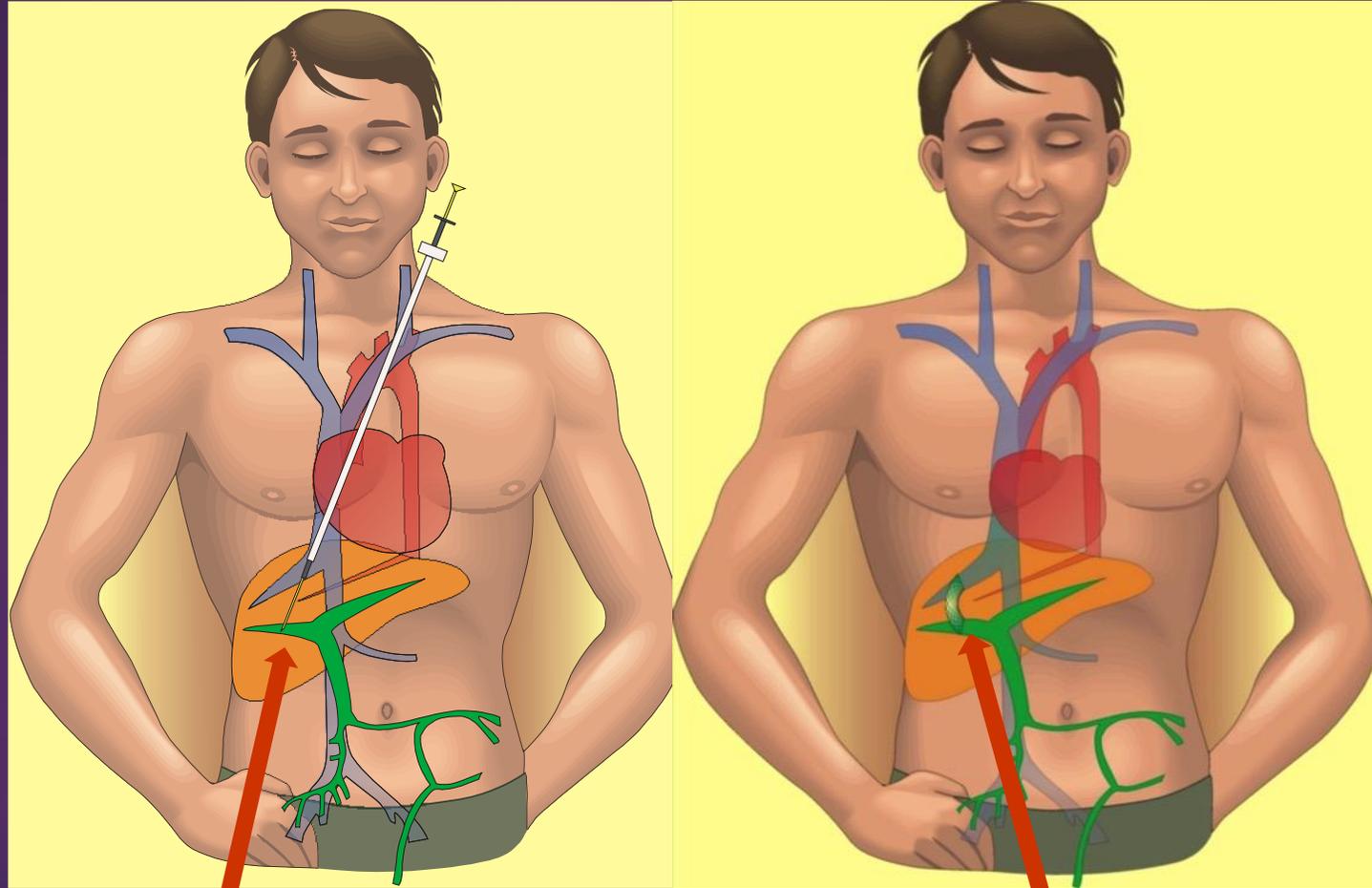
Symptoms

- bleeding from varices in esophagus/stomach
- ascites (*abnormal fluid in the belly*)

IR treatment

- Embolization (closure of varices)
- TIPS (*new blood channel through the liver*)

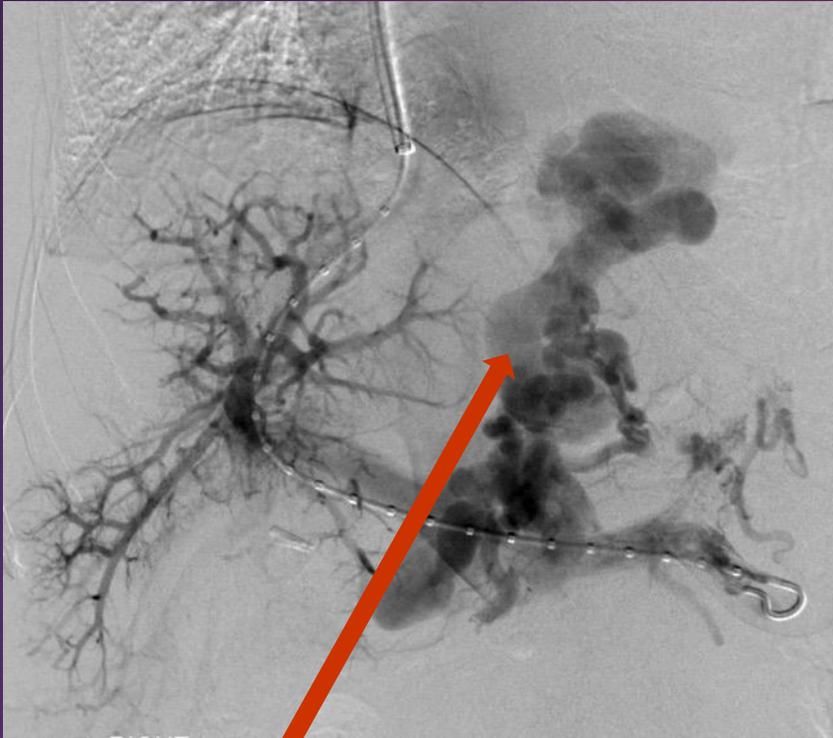
IR in liver cirrosis - TIPS



Puncture through the liver

Stent in channel through the liver

IR in liver cirrhosis - TIPS



Varicose veins, bleeding



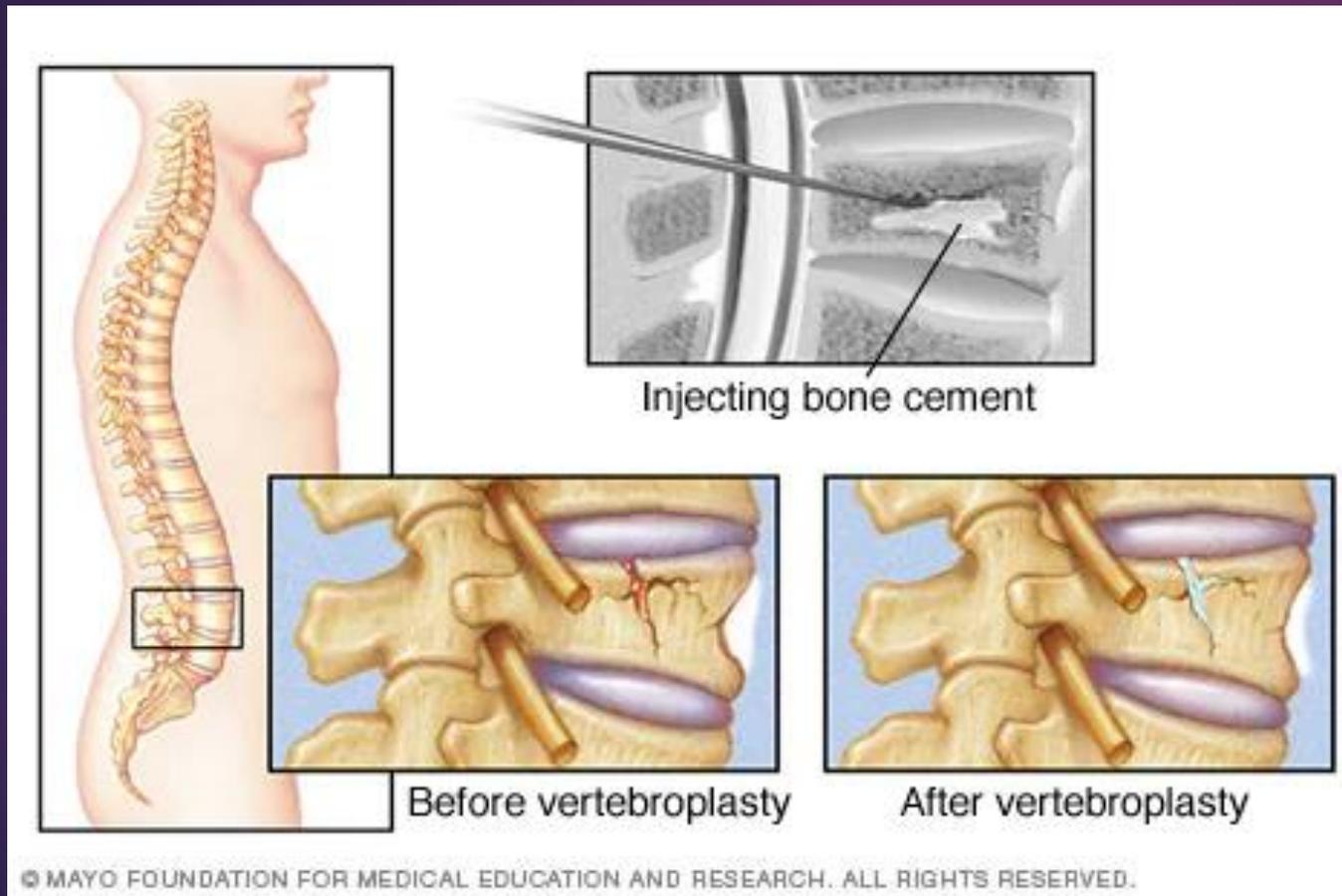
Flow to the heart through the TIPS

Nephrostomy & Ureteric Stent

- ▶ If the kidney becomes blocked by stones or tumours we insert a needle through the skin into the kidney using ultrasound to guide us. Once inside the kidney we use x-rays to guide a wire down to the bladder and insert a stent between the kidney and bladder to bypass the blockage.



Kyphoplasty and Vertebroplasty in vertebral fractures

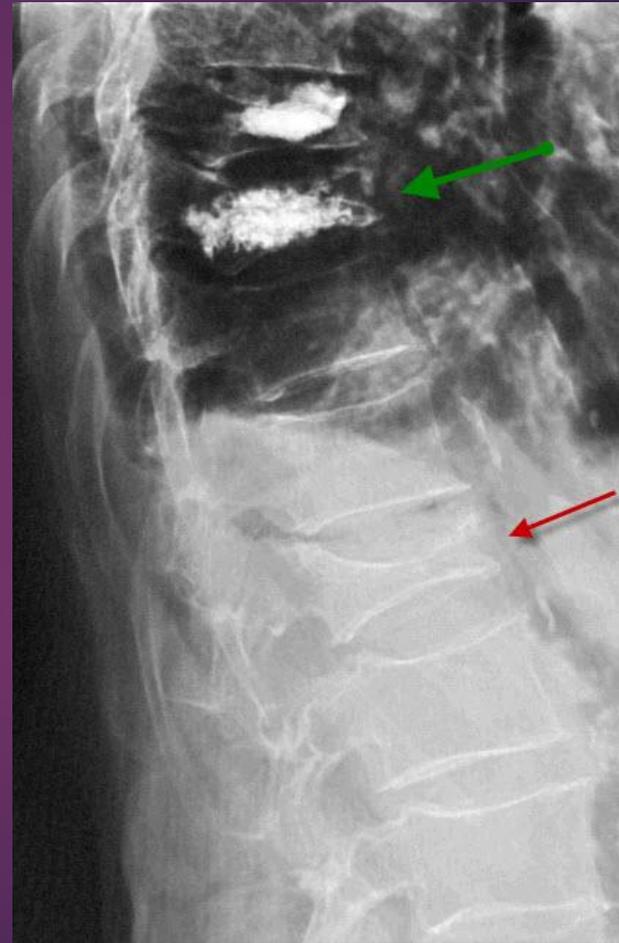


Kyphoplasty and Vertebroplasty

- ▶ Epidemiology of osteoporotic fractures
- ▶ Natural history
- ▶ Morbidity and mortality
- ▶ Conservative treatment
- ▶ Vertebroplasty/Kyphoplasty
- ▶ How its done
- ▶ Selection of patients and imaging

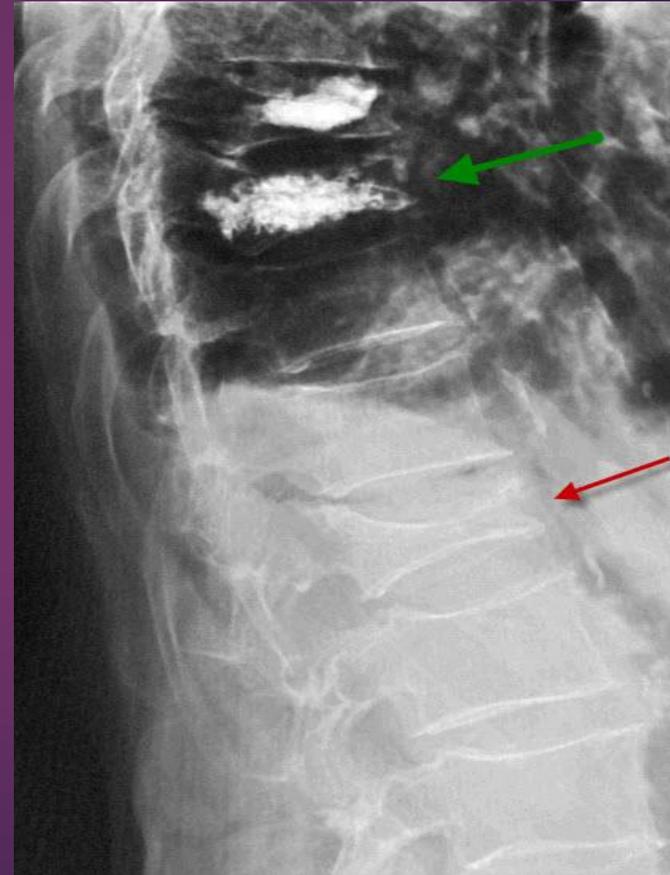
Epidemiology Radiographic

- ▶ 25 % in post menopausal females
- ▶ 40% in women > 80yrs
- ▶ Age group 65 yrs+ are fastest growing segment of the population
- ▶ Less common in men
- ▶ Melton et al. Epidemiology of vertebral fractures in women. Am J Epidemiol 1989; 129:1000-11.



Consequences of vertebral fractures

- ▶ Sentinel sign of failing health
- ▶ 35-40% increase in cancer deaths
- ▶ 23-34% increase in mortality rates
- ▶ 5yr survival 61% cf. 76%
- ▶ Cooper C et al. Population based study of survival after osteoporotic fractures. *Am J Epidemiol* 1993;137:1001-5.



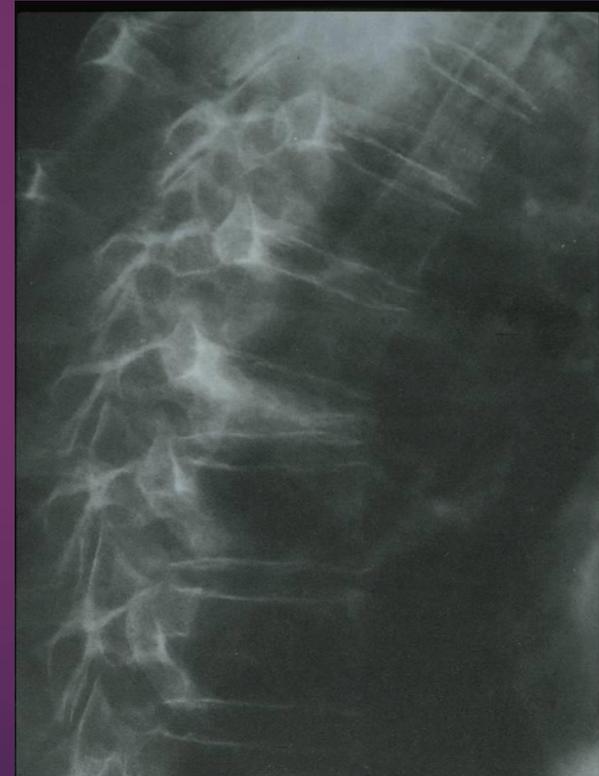
Clinical incidence

- ▶ Majority are asymptomatic
- ▶ Loss of height and stooped posture
- ▶ 23-33% are painful
- ▶ Over $\frac{2}{3}$ rds become manageable or asymptomatic in 6-12 weeks
- ▶ Cooper C et al. The epidemiology of vertebral fractures. Bone 1993-14.611-5



Predictors of fracture

- ▶ Age
- ▶ Sex
- ▶ Osteoporosis
- ▶ Inactivity
- ▶ Smoking
- ▶ 20-30% are multiple
- ▶ Previous fracture



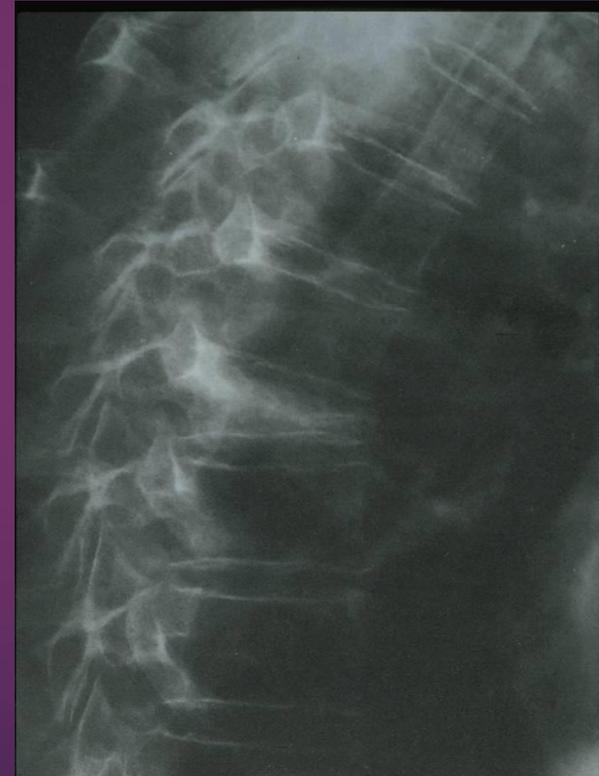
Predictors of fracture

Predictors of fracture

19.2% of females with a confirmed incidental fracture had a second fracture within one year.

24% of females with two or more fractures developed a further fracture within a year.

Lindsay et al. JAMA 2001; 285: 320-3.



Evaluation

- Severe back pain
- Often no history of trauma
- Pain is worse upright
- Thoracic kyphosis
- Pain reproduced by pressure over spinous process
- Very rare neurological deficit
- Exclude other causes



Evaluation

Think twice!

- ▶ Fractures above T6
- ▶ Less than 55 yrs without history of trauma
- ▶ Patients with known malignancy



Radiographic evaluation of age of fracture

▶ Plain films

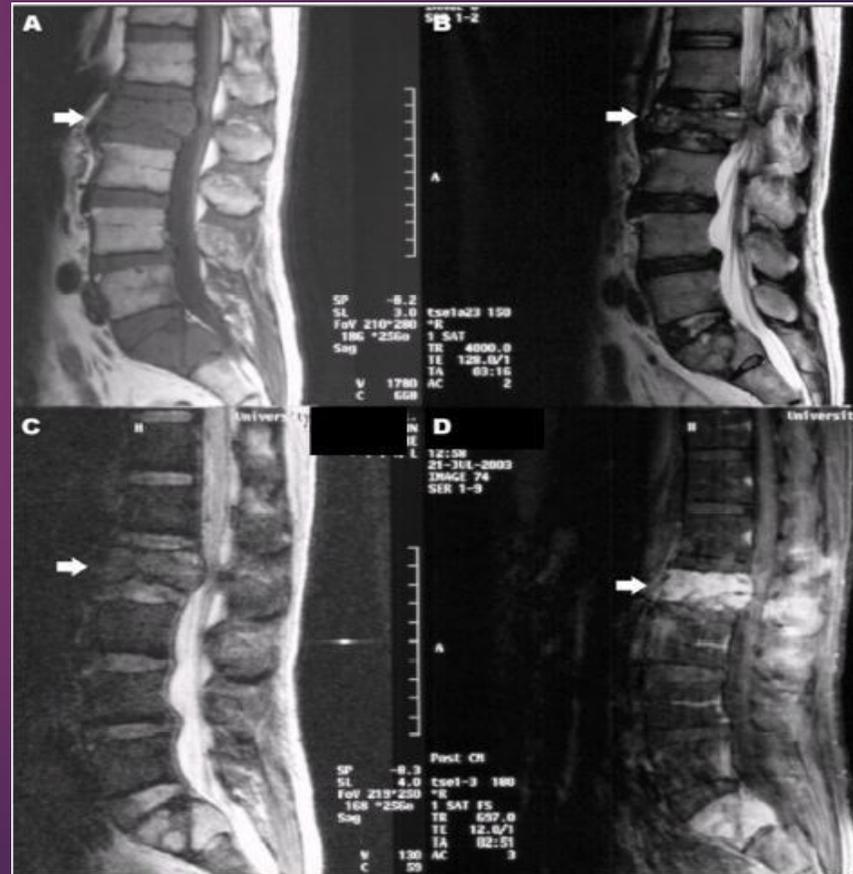
▶ MRI

Low signal T1

High signal T2

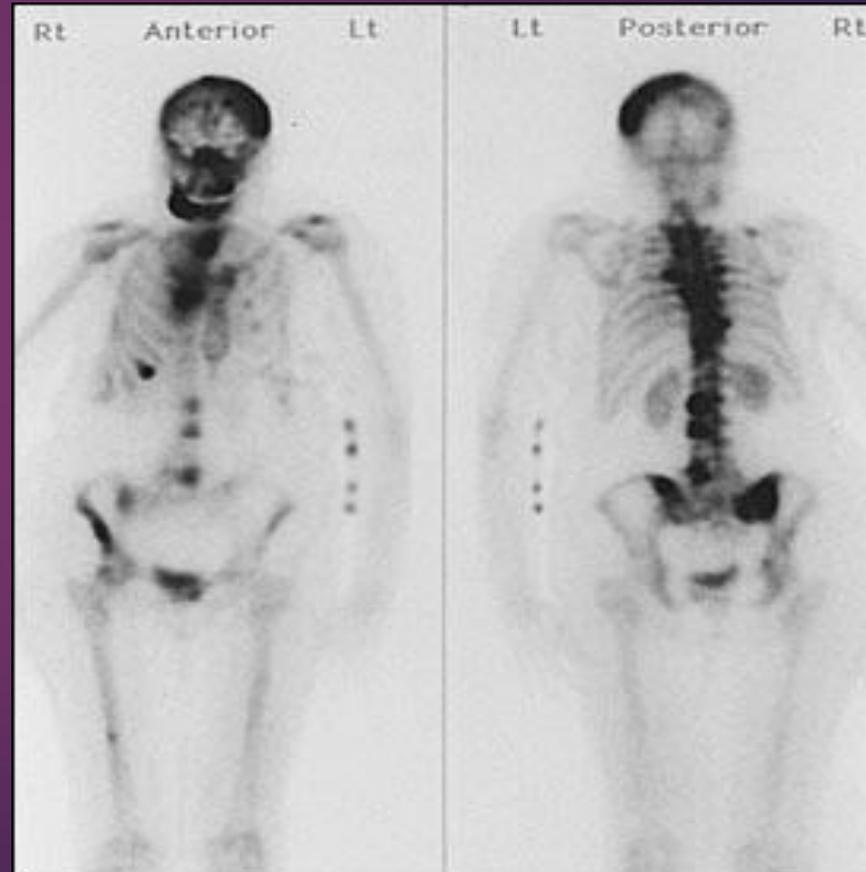
High signal STIR

Best indicator of age is the history.



Bone Scan

- ▶ Not as commonly used as MRI
- ▶ Been show to have a 93% predictive value in vertebroplasty!
- ▶ May be abnormal when MRI is normal
- ▶ Maynard et al. Value of bone scan imaging in predicting pain relief in vertebroplasty. AJNR 2000;21:1807-12.



Treatment

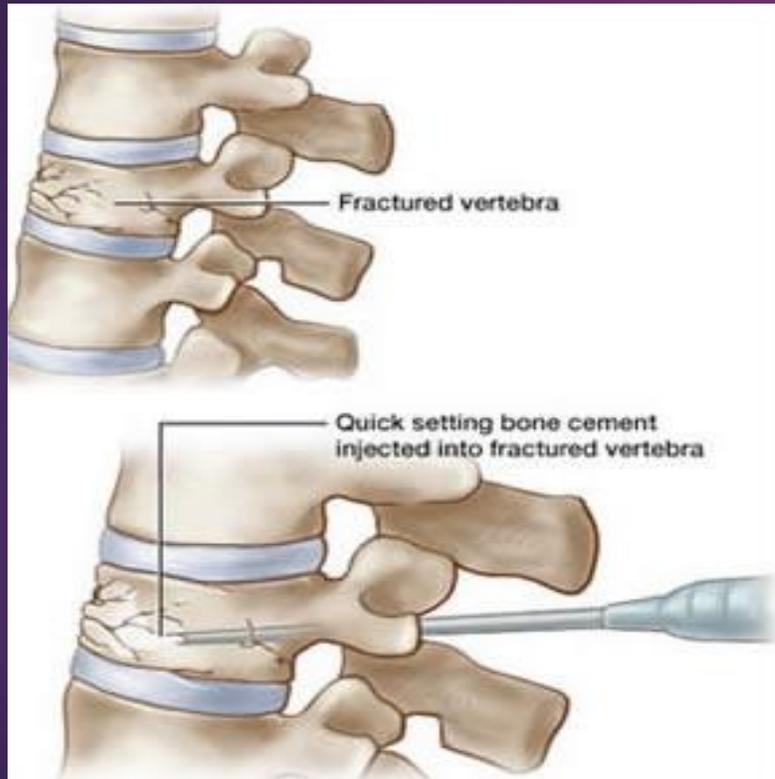
- ▶ Pain relief
- ▶ Exercise
- ▶ Diet
- ▶ Osteoporosis
- ▶ Brace?



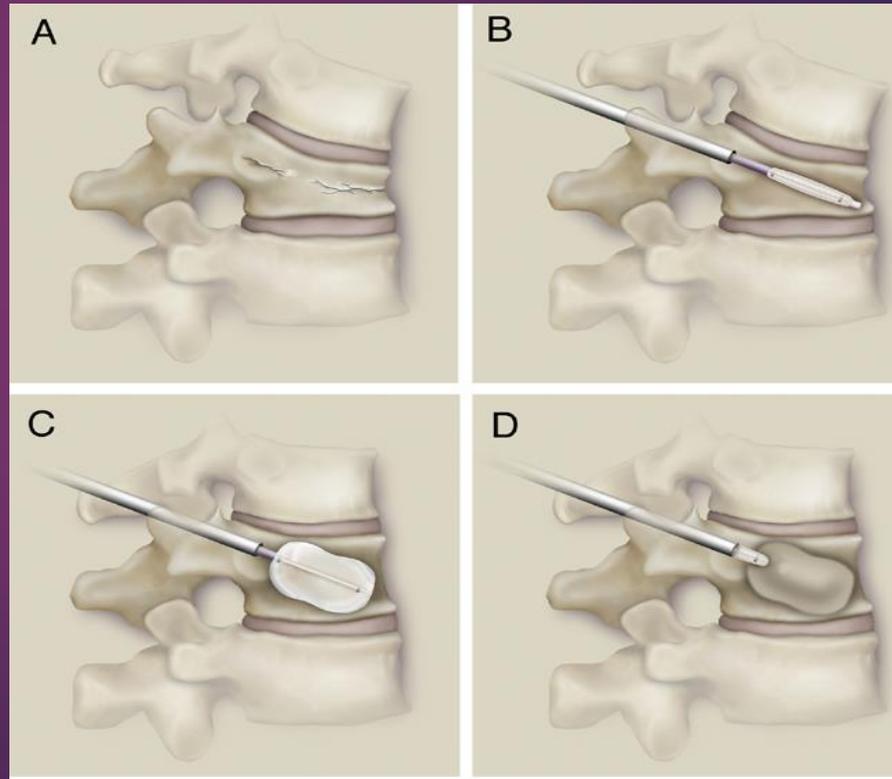
Vertebroplasty / Kyphoplasty

What is it?

Vertebroplasty



Kyphoplasty



How does it work?

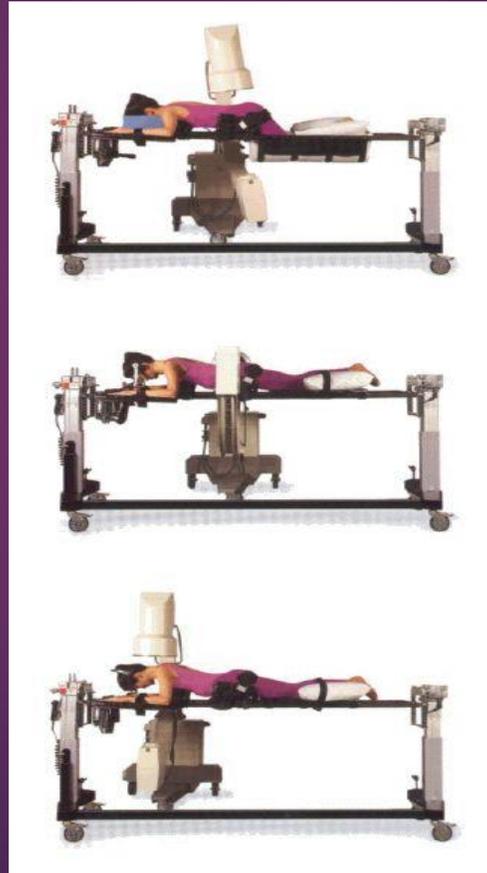
- ▶ Structural support – but no good correlation with amount of cement injected
- ▶ Thermal properties
- ▶ Decompression
- ▶ Placebo

How is it done?

- ▶ Usually performed under general anaesthetic
- ▶ Can be performed under local
- ▶ Day case procedure
- ▶ Minimal invasive



How is it done?



How is it done?



How is it done?

Vertebroplasty



Kyphoplasty



How is it done?



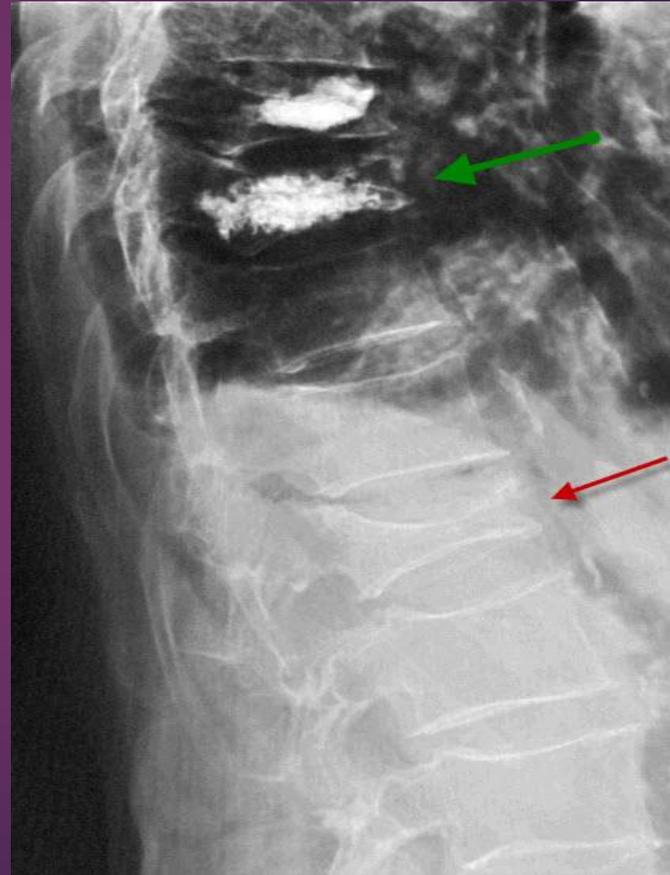
Indications for vertebroplasty/kyphoplasty

- ▶ Only needed in a small subset of patients
- ▶ High signal on STIR.
- ▶ Pain on percussion
- ▶ Increased activity on bone scan
- ▶ T5 and below-kyphoplasty
- ▶ Timing?



Contraindications

- ▶ Infection
- ▶ Uncorrectable coagulopathy
- ▶ Anaesthetic Risk
- ▶ Neurology
- ▶ Middle column compromise is NOT.



Complications

- ▶ Very few cliniccal relevant complications.
- ▶ Cement extravasation 70%+
- ▶ Pulmonary embolus 70%+

Vertebroplasty v Kyphoplasty

Vertebroplasty

- ▶ Cheaper
- ▶ Quicker

Kyphoplasty

- ▶ Expensive
- ▶ Takes longer
- ▶ Restoration of vertebral height?
- ▶ Less adjacent fractures
- ▶ Less cement leakage
- ▶ Quality of life↑

Results

Vertebroplasty

- ▶ Significant better pain and functional improvement than conservative treatment at 3 months.
- ▶ No difference at twelve months.
- ▶ Vertebroplasty patients had significantly more pain than the conservative group.
- ▶ Hulme PA et al. Vertebroplasty and kyphoplasty: a systematic review of 69 clinical studies. Spine 2006;31;1983-2001.

Kyphoplasty

- ▶ FREE trial.
- ▶ 300 patients randomised.
- ▶ Assessed at one year
- ▶ SF 36 PCS 0-100.
- ▶ Kyphoplasty 26 → 33.4
- ▶ Conservative 25.5 → 27.4

p<0.0001

Wardlaw D et al Lancet
2009;21:1016-24

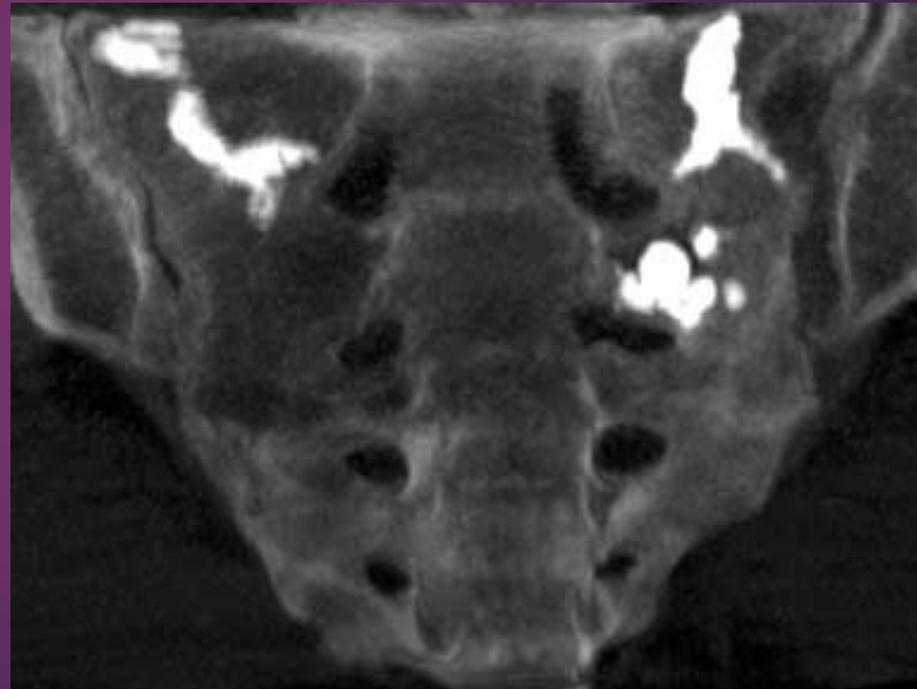
Other Uses

- ▶ Tumours
- ▶ Trauma
- ▶ Myeloma



Other uses

- ▶ Sacroplasty
- ▶ Sacral insufficiency fractures
- ▶ Best performed under CT guidance.



Developments

- ▶ Calcium phosphate in young patients with traumatic fractures
- ▶ Prophylaxis
- ▶ Adding chemotherapy agents or radioactive isotopes to the cement in tumour

Conclusions

- ▶ Vertebroplasty/Kyphoplasty is useful in the treatment of vertebral osteoporotic fractures although some controversy still exists.
- ▶ Low morbidity
- ▶ Should be considered in painful fractures over 6 weeks old.

- 
- ▶ Biopsy is a surgical procedure to obtain tissue from a living organism for its microscopical examination, usually to perform a diagnosis.

Indications for Biopsy

- ▶ Inflammatory changes of unknown cause that persist for long periods
- ▶ Lesion that interfere with local function
- ▶ Bone lesions not specifically identified by clinical and radiographic findings
- ▶ Any lesion that has the characteristics of malignancy

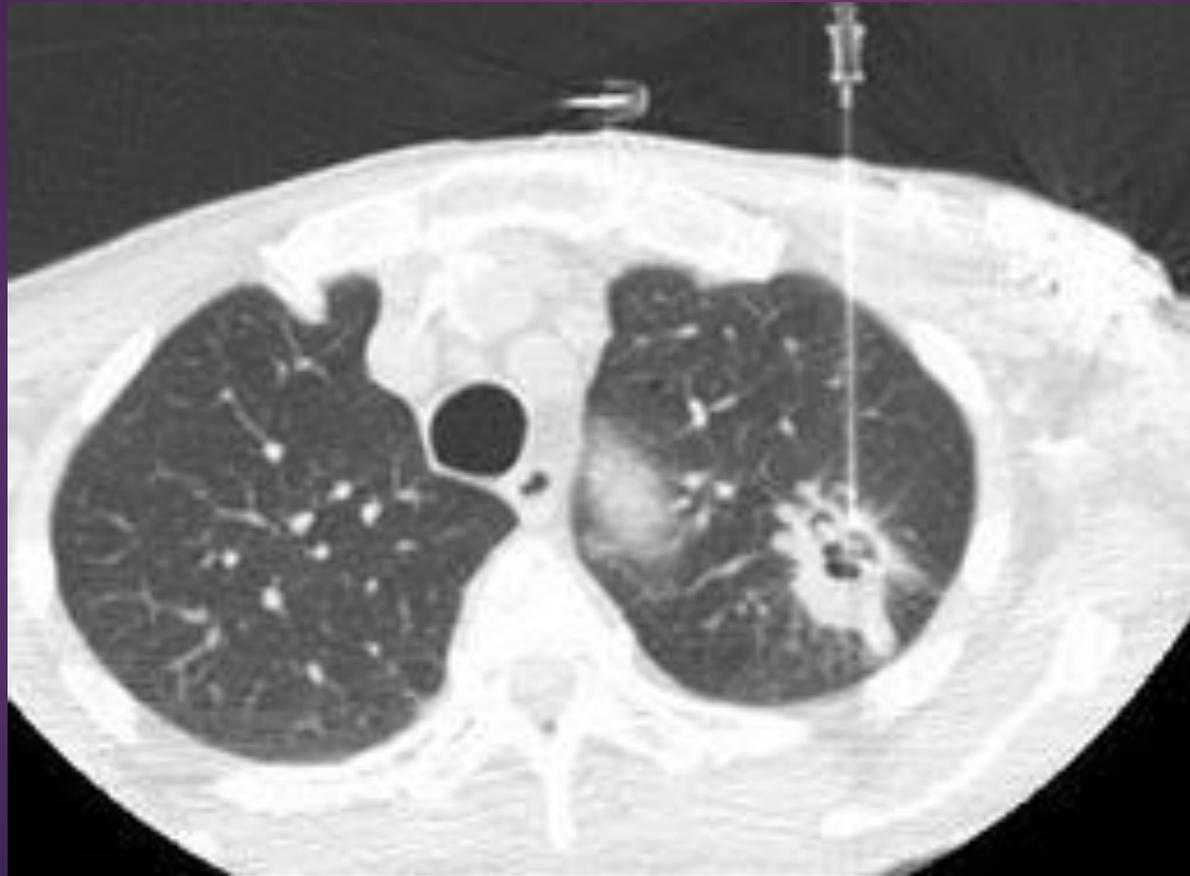
Characteristics of lesions that raise the suspicion of malignancy.

- ▶ Erythroplasia- lesion is totally red or has a speckled red appearance.
- ▶ Ulceration- lesion is ulcerated or presents as an ulcer.
- ▶ Duration- lesion has persisted for more than two weeks.
- ▶ Growth rate- lesion exhibits rapid growth
- ▶ Bleeding- lesion bleeds on gentle manipulation
- ▶ Induration- lesion and surrounding tissue is firm to the touch
- ▶ Fixation- lesion feels attached to adjacent structures

Image Guided Biopsies

- ▶ Using ultrasound or CT guidance we can insert a needle to nearly anywhere in the body and obtain a sample of tissue to assess whether there is infection or tumour or other types of disease present at this location.
- ▶ The image below shows a CT image of a needle being inserted into a lung cancer. Patients for this procedure can be referred to us by any medical or surgical specialty.
- ▶ It is usually performed under local anaesthetic. Some procedures can be performed as day case procedures but often patients are cared for on a ward following the procedure for close observation and monitoring.

CT guided biopsy



Aspiration Biopsy

- ▶ Aspiration biopsy is the use of a needle and syringe to remove a sample of cells or contents of a lesion.
- ▶ The inability to withdraw fluid or air indicates that the lesion is probably solid

Aspiration Biopsy

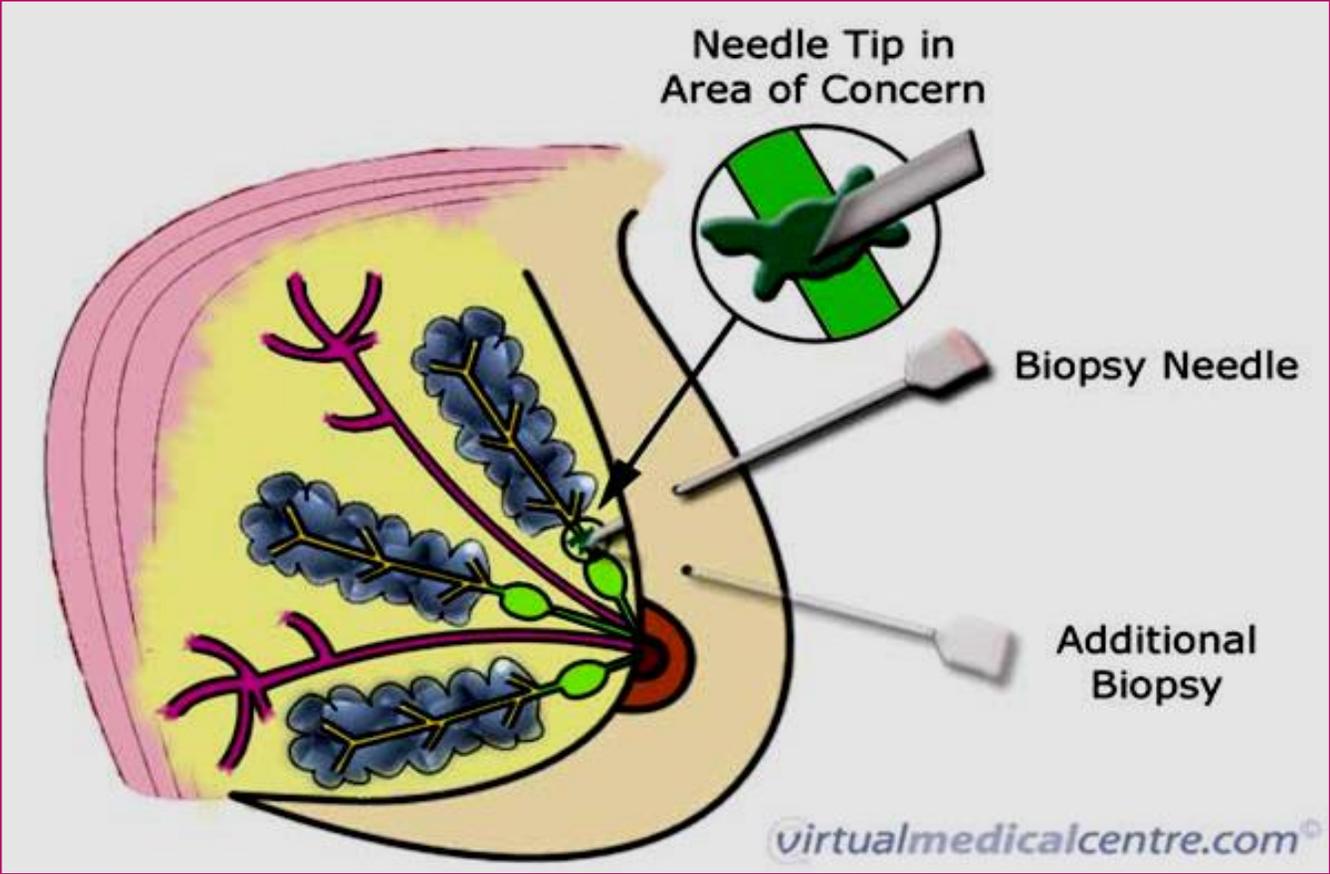
Indications:

- ▶ To determine the presents of fluid within a lesion
- ▶ To a certain the type of fluid within a lesion
- ▶ When exploration of an intraosseous lesion is indicated

- ▶ A Fine Needle Aspiration (FNA) Biopsy is a simple procedure that involves passing a thin needle through the skin to sample fluid or tissue from a cyst or solid mass.
- ▶ The sample of cellular material taken during an FNA is then sent to a pathology laboratory for analysis.

- Fine needle aspiration biopsies are often performed when a suspicious mass is found, for example a breast lump/mass or enlarged lymph node, or if an abnormality is detected on an imaging test such as x-ray, ultrasound or mammography.

- ▶ **Fine needle aspiration is a relatively non-invasive, less painful and quicker method when compared to other methods of tissue sampling such as surgical biopsy.**
- ▶ **A cyst aspiration can also be achieved with a FNA, where the fluid is drained from a cyst with no need for analysis.**



Performing FNA biopsy

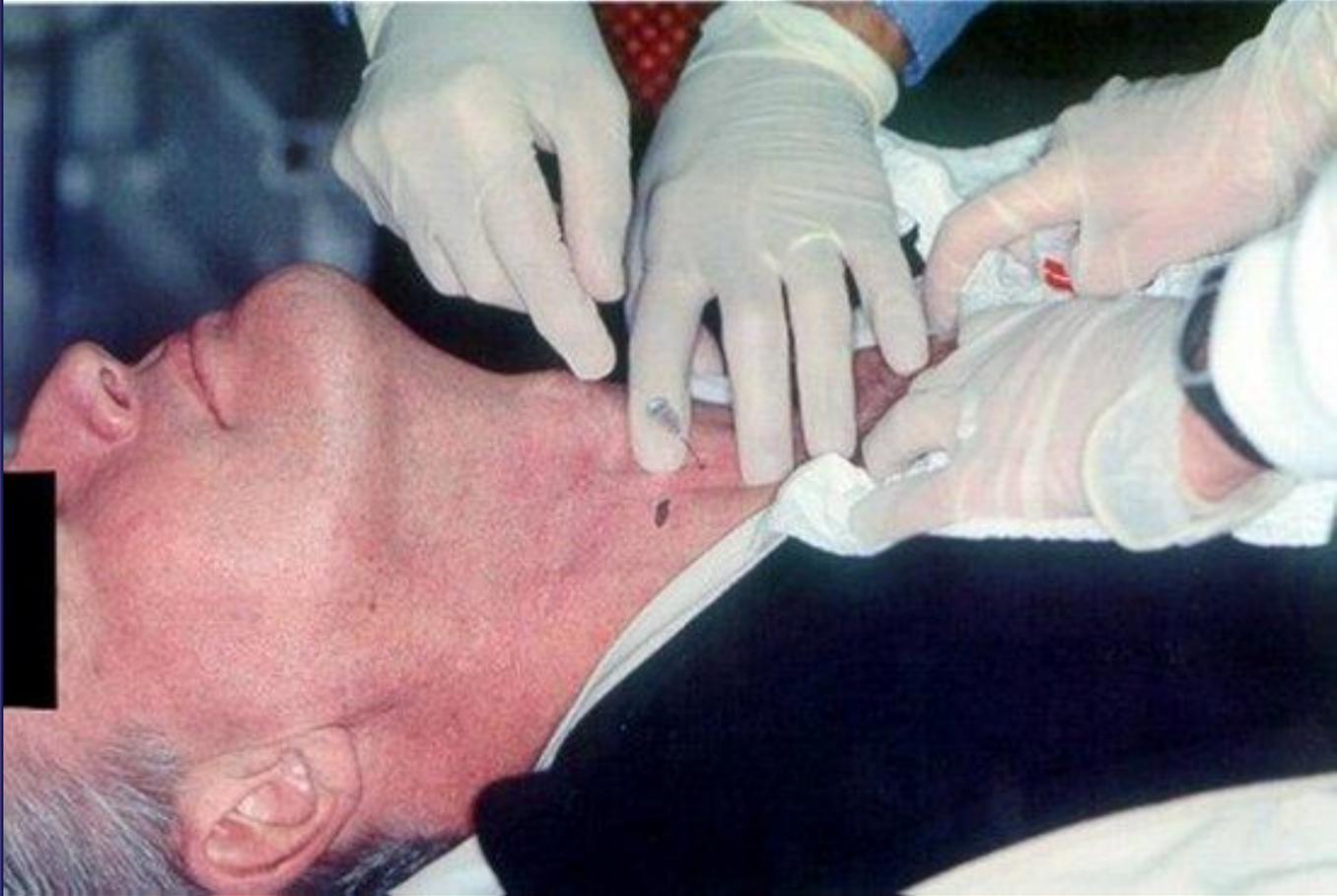
- ▶ **A fine needle aspiration biopsy is performed to collect a sample of cells or fluid from a cyst or solid mass, to allow the cells to be examined microscopically.**
- ▶ **Local anaesthetic is not usually required for a fine needle aspiration, as the procedure should not be painful.**

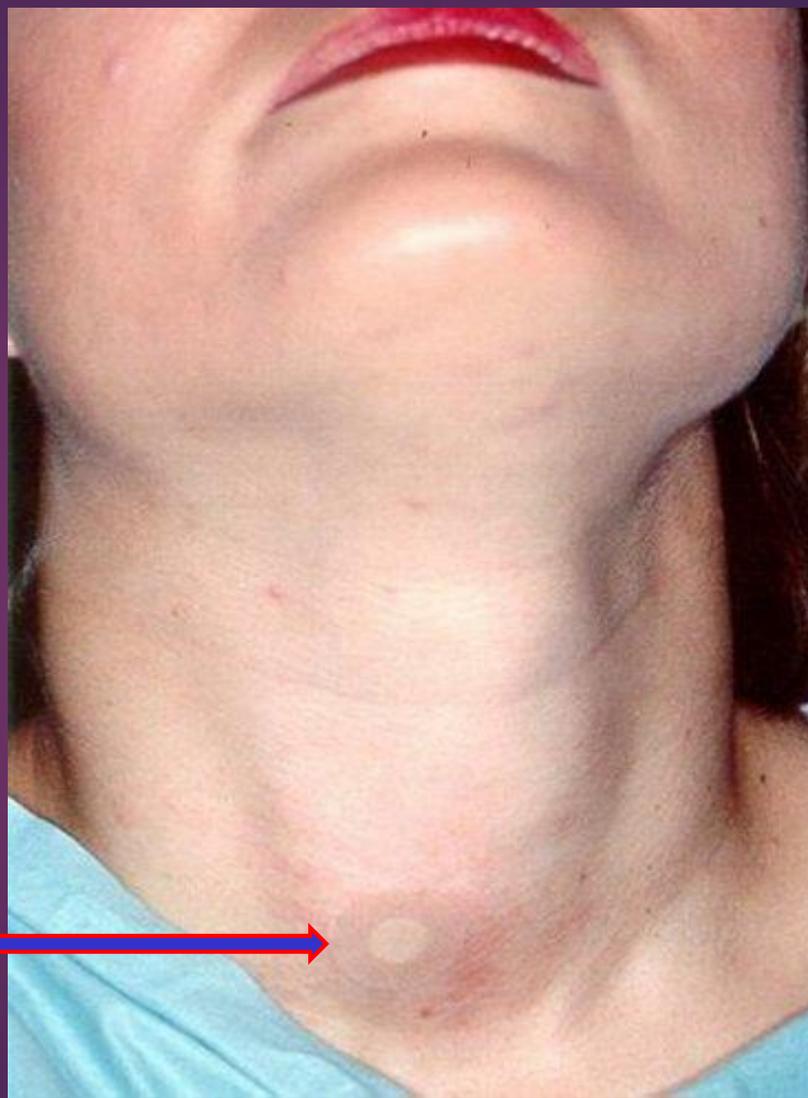
- ▶ **Fine needle aspirations may be performed on palpable lump/mass (mass which can be felt), or impalpable lumps which have been detected on ultrasound or x-ray.**
- ▶ **Once the skin has been cleaned at the needle entry point, the sample was aspirated and is then examined.**

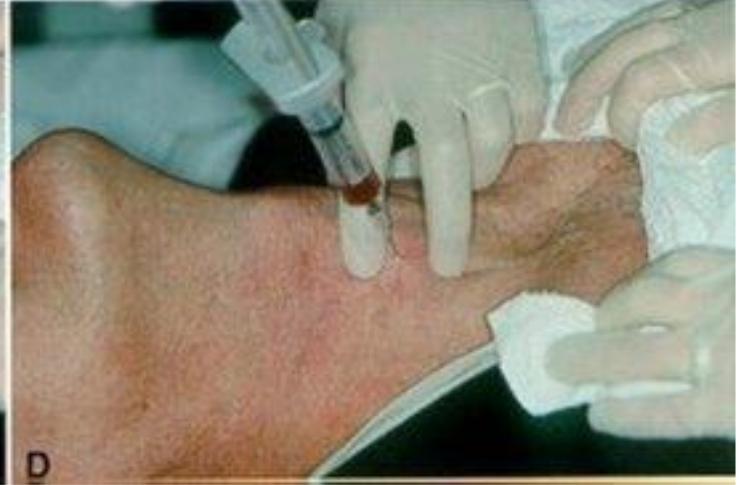
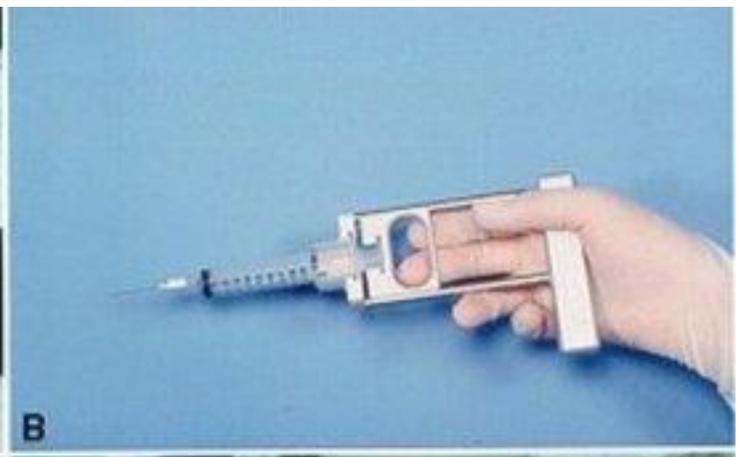
- ▶ **If the lump cannot be felt, imaging may be required to find the exact location. This can be done with ultrasound, where the surgeon will watch the needle on the ultrasound monitor and guide it to the area.**
- ▶ **The type of needle used for fine needle aspiration biopsy has a hollow interior and is much finer than a regular needle used to draw blood.**

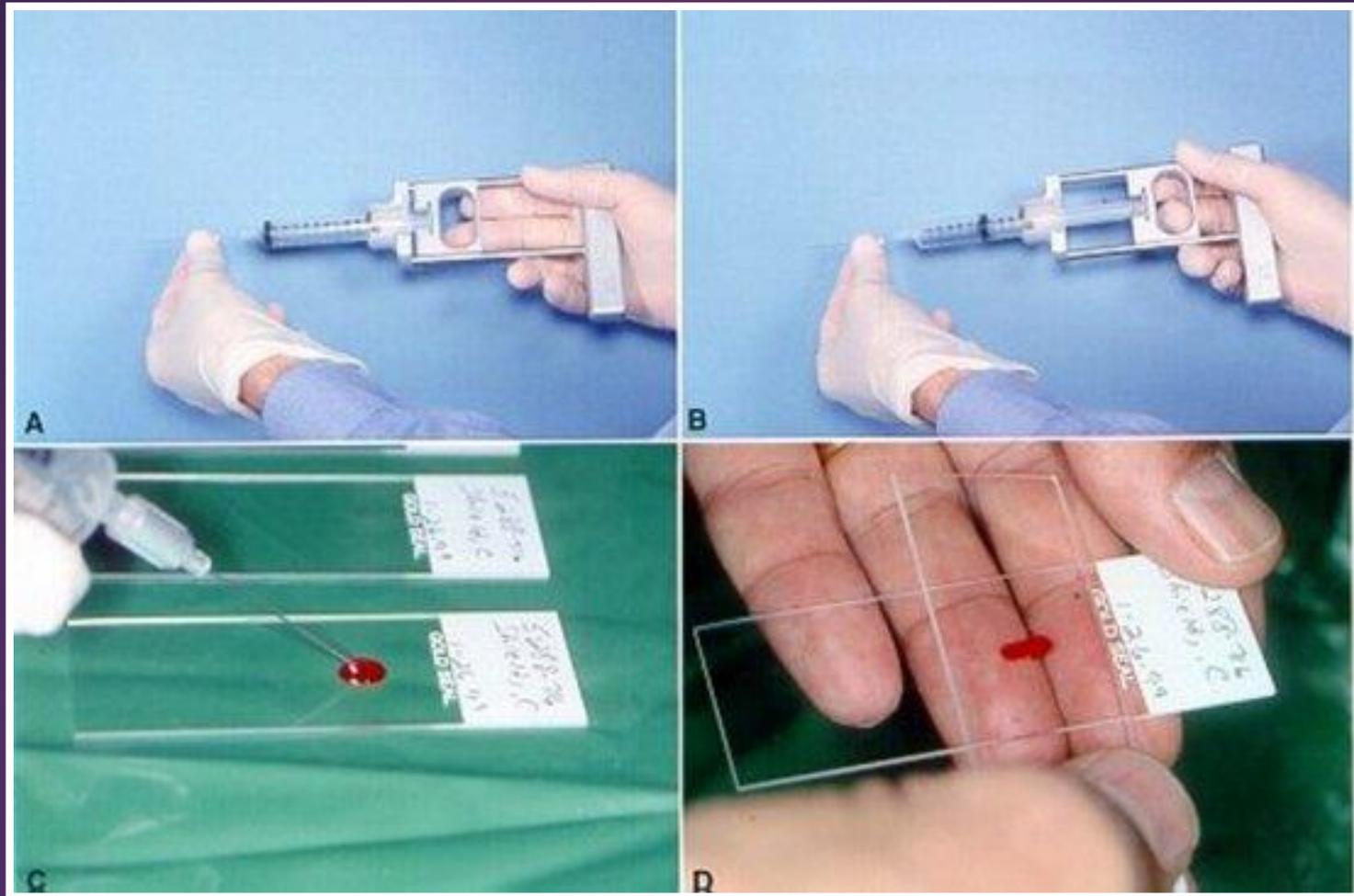
- ▶ **Several needle insertions may be required to ensure that the sample is adequate.**
- ▶ **Once the test is completed, a small bandage will be placed over the site and the patient continue his normal activities.**
- ▶ **There are generally no complications with this procedure, however some patients may experience tenderness over the needle insertion site, bleeding, swelling, fever or pain.**











How is the FNA Biopsy performed

- ▶ Holding the mass with one hand, the doctor will precisely sample the mass with a thin needle held in a needle holder, which provides greater control.
- ▶ Usually, 2 to 3 samples will be required from the mass to provide an accurate diagnosis.

- 
- ▶ **During the procedure, the doctor will usually leave the examination room with one of the slides to check that there is enough tissue to prevent the need for a second office visit.**

How long does it take

- ▶ Each sample will only take about **10 seconds** to obtain.
- ▶ The whole procedure from start to finish usually takes no more than **10 to 15 minutes**.

Result of FNA

- ▶ The samples taken are examined under a microscope.
- ▶ A detailed report will then be provided about the type of cells that were seen, including any suggestion that the cells might be malignant.

- 
- ▶ It is important to remember that having a mass does not necessarily mean that it is malignant; many fine needle aspiration biopsies reveal that suspicious lumps or masses are benign (non-cancerous) or cysts.
 - ▶ **Benign:** There are no cancerous cells present. The lump or growth is under control and has no spread to other areas of the body.



- Atypical/indeterminate, or suspicious of malignancy:

The results are unclear. Some cells appear abnormal but are not definitely cancerous. A surgical biopsy may be required to adequately sample the cells.

- Malignant: The cells are cancerous, uncontrolled and have the potential or have spread to other areas of the body.

- 
- ▶ **The results can be grouped into 3 categories:**
 - ▶ **Clearly Benign (not cancer)**
 - ▶ **Clearly Malignant (cancer)**
 - ▶ **Non-Definitive, Less Clear (most often, this will be followed by a surgical biopsy)**

Effectiveness of FNA

- ▶ A fine needle biopsy is an effective tool in evaluating and diagnosing suspect lumps or masses.
- ▶ A quick diagnosis can mean that cancer is detected early, giving more options for treatment.

- 
- ▶ **It is non-invasive and only slightly uncomfortable, and not require general anaesthetic compared to a surgical biopsy.**
 - ▶ **Fine needle aspiration biopsies require some expertise to perform and interpret.**

Benefits and risks of FNA

- ▶ Compared to a surgical biopsy, fine needle aspiration biopsy involves little possibility of scarring, infection or pain, and has a significantly shorter recovery time.
- ▶ **It is also extremely useful in the diagnosis and treatment of cysts.**
- ▶ The risks of FNA biopsy include the possibility of cancer cells being trailed into unaffected tissue as the needle is removed, but this is rare when the test is performed by skilled practitioners.

- 
- ▶ **Because an FNA biopsy can only sample a small number of cells from a mass or lump, there is a risk that many abnormal cells may be missed and not detected.**
 - ▶ **This may mean that a larger sample must be taken, for example by core needle biopsy.**

FNA Biopsy or Core biopsy

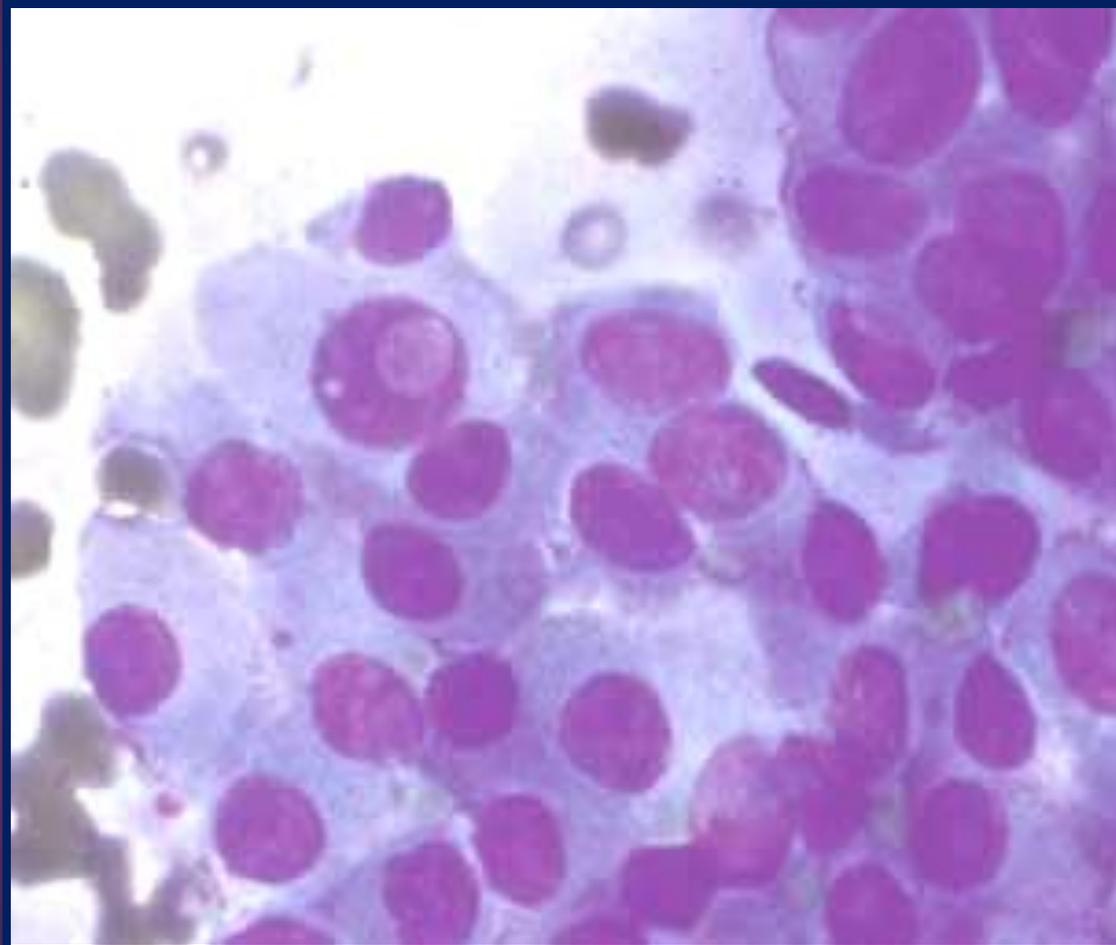
- ▶ Core Biopsy is another method of 'tissue diagnosis' - that is, a way of sampling the cells in a suspicious lump or mass.
- ▶ It is sometimes used instead of fine needle aspiration biopsy, or vice versa.

- ▶ **Core biopsy is more invasive procedure than FNA, as it may involve making a small incision (cut) in the skin.**
- ▶ **A large needle is then passed through this incision and several narrow samples of the tissue to be investigated (such as a lump) are taken.**
- ▶ **A core biopsy may result in a small, very fine scar where the incision was made.**

- ▶ As with fine needle aspiration, ultrasound guidance may be needed to locate the mass or area to be sampled.
- ▶ Core biopsy is done under local anaesthetic.
- ▶ The procedure usually takes between 30 – 60 minutes.
- ▶ After the procedure, the biopsy area will be covered with a simple dressing.

- ▶ **The samples of tissue taken during a core biopsy differ from those taken during FNA.**
- ▶ **Because the cells from a FNA biopsy are sucked up randomly into the needle, they are seen under the microscope as a disorganised jumble of cells (see the next image).**

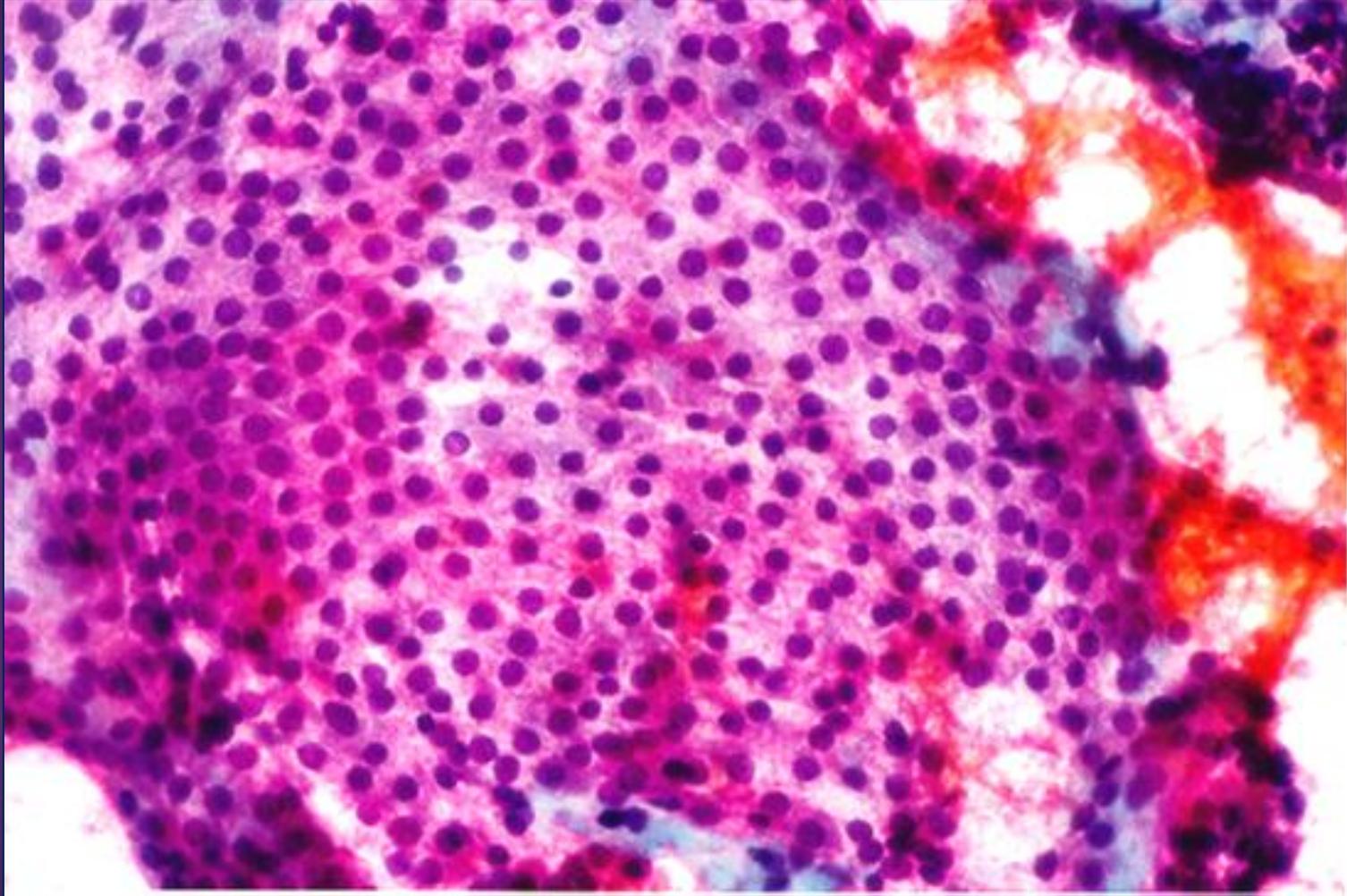
FNA BIOPSY



- 
- ▶ **With a core biopsy sample, however, the larger needle allows the cells to be removed with their relationship to each other intact.**

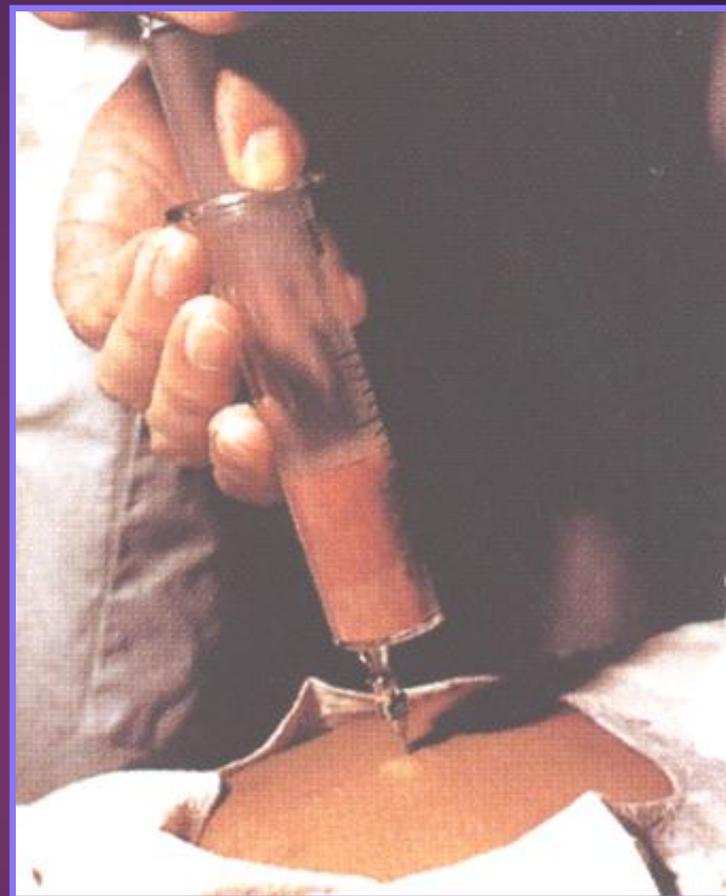
This can sometimes help in given more accurate diagnosis.

core biopsy

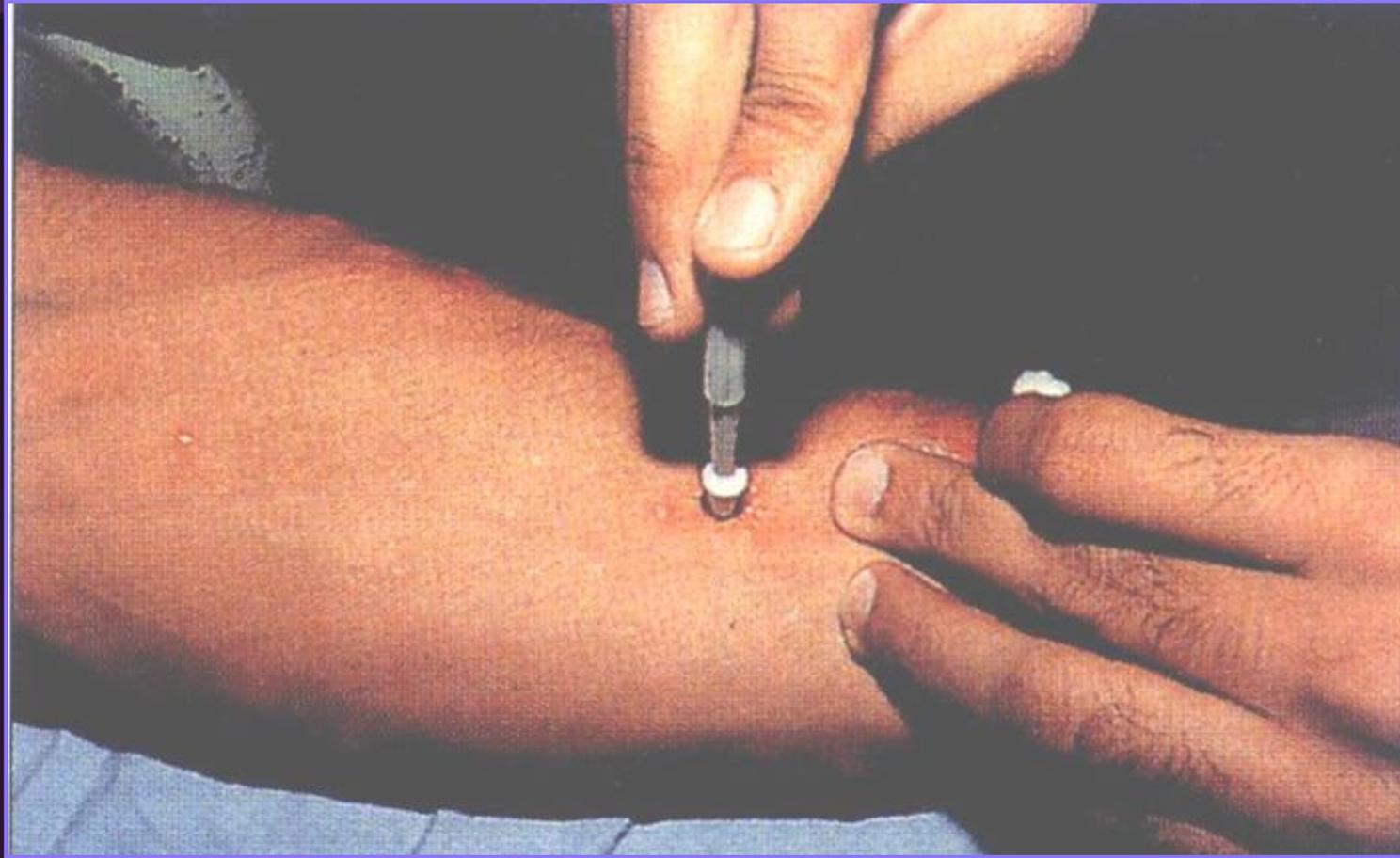




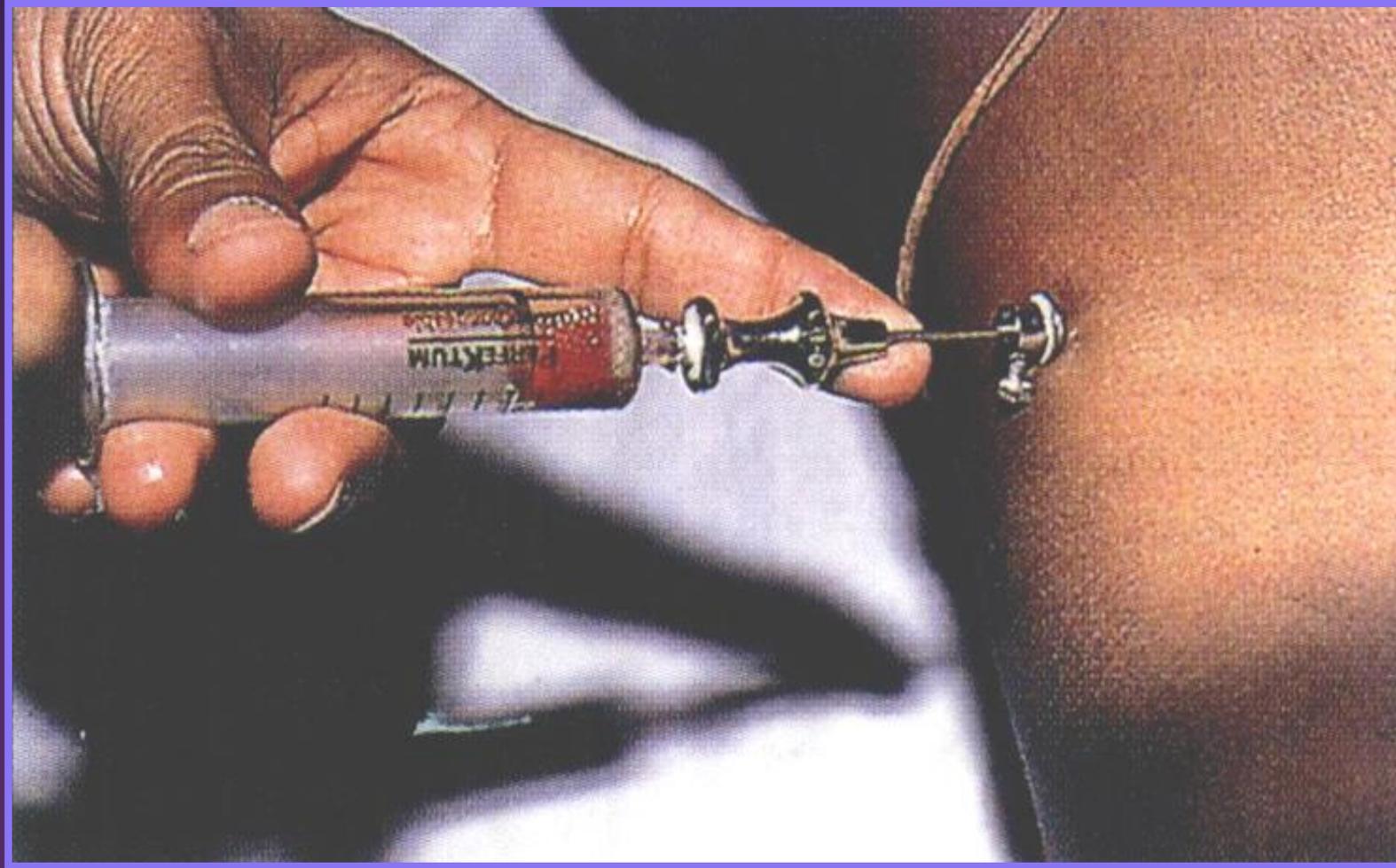
Lumbar puncture



Aspiration of liver cyst



Punch biopsy with a disposable skin punch



Iliac crest puncture of bone marrow

THANK YOU!