Summary

Pain is "an unpleasant sensory and emotional experience, associated with actual or potential tissue damage, or described in terms of such damage". There are two very important points to notice in this definition:

Every tissue in your body is supplied by special nerve receptors called 'nociceptors'. These are nerves which are specially designed to detect painful (or 'noxious') stimuli, for example extreme heat, mechanical damage like a pinch, or irritating chemicals. When the nociceptors detect a painful stimulus, the nerve will fire off an impulse which travels back along the nerve fibre to your spinal cord. From there, the pain message is conveyed up to the brain via a spinal neuron (nerve), travelling up through a part of the brain called the thalamus before ending in many different areas of the brain's cortex. The parts of the brain that the pain signals are sent to are important because they affect the way we perceive pain.

Intravenous regional anesthesia (IVRA) is a technique whereby tourniquet cuffs (usually pneumatic) are used to restrict blood flow to a body part such as an exsanguinated limb and retain anesthetic locally in the limb during surgical procedures.

This simple method of providing anesthesia of the distal arm or leg was first described by August Bier in 1808. After a period of wide popularity, it fell into disuse until repopularised by Holmes in 1963.
Clinical application. Intravenous regional anesthesia (IVRA) is indicated for any procedure on the arm below the elbow or leg below the knee that will be completed within 40-60 minutes. Onset of anesthesia is rapid and reasonable muscle relaxation can be obtained. Its use is limited to

procedures lasting less than an hour because of increasing discomfort from the tourniquet.

Contra-indications. The technique should not be employed if a tourniquet cannot safely be used, for example, in patients with severe Reynaud's or homozygous sickle cell disease. IVRA is not contraindicated in patients who are heterozygous for sickle cell disease. Caution should be employed in patients who have sustained crush injuries of the relevant limb as potentially viable tissue will be subjected to a further period of hypoxia.

Equipment. The only equipment necessary to perform this procedure successfully is a tourniquet which does not leak and that can be inflated to a pressure at least 50mmHg above the patient's systolic blood pressure, and a cannula inserted in a distal vein. As with all other local anesthetic blocks, resuscitation equipment should be immediately available.

A tourniquet is a cloth - and - stick device used to stop bleeding in an emergency. Yes, that is a tourniquet. But modern surgical tourniquets are also much more. Today, surgical tourniquets are specifically designed to enable surgeons to perform delicate dissections in a bloodless operative field. They use compressed gas to apply a carefully controlled amount of pressure to an extremity. Some computerized tourniquet systems perform self - checks of calibration, display elapsed inflation time, and sound alarms if problems arise. And problems can arise: equipment can malfunction and patients can be injured.

Drugs. The drug of choice for IVRA is prilocaine as it is the least toxic local anesthetic and has the largest therapeutic index. If prilocaine is not

available, lignocaine is an acceptable alternative. It is essential that plain and not adrenaline-containing solutions are used. Bupivacaine (Marcain) is not suitable and should never be employed as it is too toxic, particularly to the myocardium. A suitable dose to use in an arm is 40ml of 0.5% prilocaine (or 0.5% lignocaine). This can be increased to 50ml in muscular individuals or decreased to 30ml in small or frail patients. Larger volumes are necessary in the leg eg. 50-60ml. Maximum recommended volumes for a 60-70 kg patient are 400mg prilocaine (80ml 0.5% solution) or 250mg lignocaine (50ml 0.5% solution).

Local anesthetics work by blocking the inward Na^+ current at the sodium ionophore during depolarization, which prevents propagation of the axonal action potential.

It was concluded that adjuvants can improve effectiveness and performance of the blockade, provide longer tourniquet tolerance, and/or favor postoperative analgesia. We prefer to take the advantages of each one and combine them.

The list of adjuvant drugs in the analysis includes:

Opioids

Phentanile: 50 to 200 μg

Meperidine: 10 to 100 mg

Morphine: 1 to 6 mg

Sufentanil: 25 μg

Tramadol: 100 mg

NSAIDS

Ketorolac: 5 to 60 mg

Tenoxican: 20 mg

AAS: 90 mg

Other drugs

Clonidine: 1 to 2 μg /kg

Muscle relaxants: Atracurium 2 mg, Mivacurium 0.6 mg, Pancuronio 0.05 mg

Neostigmine: 0.5 to 1mg

Alkalinization sodium potassium

Increase of the temperature of the solution

Technique. Before beginning to perform the block, the patient's blood pressure should be measured.

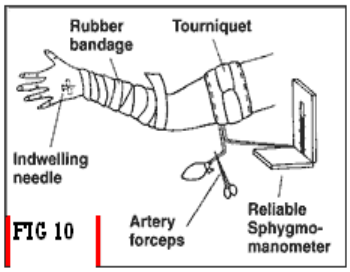

FIG 10

An intravenous cannula or butterfly needle is then inserted in a distal vein in the limb scheduled for surgery (eg. in the dorsum of the hand or foot). It is good practice to place a cannula in another limb as well in case any complications (see below) occur, which may require

intravenous drug administration. The tourniquet is then applied to the upper arm or thigh. It should never be placed on the forearm or lower leg as adequate arterial compression cannot then be obtained.

A more effective block is obtained if the limb is exsanguinated (blood removed) before the tourniquet is inflated. Traditionally, this is done by tightly wrapping the distal part of the limb with an Esmarch rubber bandage, before inflating the tourniquet. However, if this is likely to cause pain to the patient eg. if the limb is fractured, it is acceptable to simply elevate the arm or leg for 20-30 seconds whilst applying firm digital pressure on the brachial (or femoral) artery. This will allow venous blood to drain from the limb whilst preventing further arterial blood entering. The tourniquet is then inflated to a pressure of 50mm Hg or more above the patient's systolic blood pressure.

The local anesthetic solution is then slowly injected into the indwelling cannula and the patient warned that the limb may start to feel hot and that the skin will take on a mottled appearance. Analgesia will occur within 3-4 minutes and surgery can then commence. Even if the surgery is completed within a few minutes, on no account should the tourniquet be deflated until at least 15 minutes has passed since the injection of the local anesthetic or serious toxic side-effects may occur. The pressure in the tourniquet must be constantly observed and maintained at least 50mm Hg above the patient's systolic blood pressure.

If the operation is prolonged, the patient may complain of pain due to pressure from the tourniquet. This may be reduced either by the subcutaneous infiltration of a few mls of local anesthetic above the tourniquet or by the use of a "double tourniquet technique." If this method is used, two tourniquets are placed on the patient's arm or leg. Initially, the more proximal (upper) one is inflated and the local

anesthetic agent injected. If the patient becomes uncomfortable, the distal (lower) tourniquet is inflated and then the proximal one is deflated.

At the end of the procedure, the tourniquet is deflated and normal sensation quickly returns. It has been suggested that if the tourniquet is reinflated again 20-30 seconds, the rate of washout of local anesthetic from the limb and hence the incidence of side-efrects is decreased. In any event, the patient should be warned that they may experience tinnitus, dizziness or transient drowsiness following deflation of the tourniquet.

Complications. Intravenous Regional Anesthesia is extremely safe and problems are few. The most important complications are due to the toxicity of local anesthetics and will occur if the tourniquet suddenly deflates soon after the local anesthetic has been injected. These will range from dizziness and tinnitus to muscle twitching, loss of consciousness and convulsions. Serious cardiac side-effects are rare and occur if convulsions are inadequately treated or if buplvacaine is used.

Convulsions due to local anesthetic toxicity are treated in the standard way: oxygen is administered, the airway is protected, by endotracheal intubation if necessary, and the convulsions terminated with intravenous diazepam or thiopentone. Deaths have been reported when convulsions have been inadequately or incorrectly managed.

Conclusion. IVRA is a simple and valuable technique that is easy to learn and perform. It is very safe provided excessive doses of local anesthetic are avoided, if the tourniquet pressure is carefully monitored and if resuscitation equipment is always immediately available.