INTRA-ARTERIAL THIOPENTONE

by

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The incidence of this accident has been variously estimated from 1 in 55,000 (Cohen, 1948) to 3 in 25,000 (Lundy, 1942). In 24 recorded cases, 9 developed gangrene. Of these, 6 required amputation of the forearm and the remaining 3 lost one or more digits. This amply illustrates the grave consequences of such a mishap.

ANATOMY

The brachial artery normally divides into the radial and ulnar arteries one centimetre below the elbow joint. At the elbow joint it is covered by the bicipital aponeurosis and deep fascia, which separate it from the medial cubital vein.

The ulnar artery is abnormal in 8 per cent of cases (Gray, 1954), when it arises above the elbow joint and may lie superficial to the flexor muscles in the forearm, lying commonly beneath the deep fascia or more rarely between the fascia and the skin.

The radial artery is abnormal in 12 per cent of cases (Gray, 1954), when it arises higher than usual and may run on the deep fascia instead of beneath it.

PATHOLOGY

The first response of the artery to intra-arterial thiopentone is intense spasm. This spasm by reducing the blood flow allows prolonged contact of the thiopentone (pH 10.5) with the intima. Thus the essential lesion is intimal damage permitting intra-arterial thrombosis. The extent of the thrombosis is related to the extent of retrograde spread of the thiopentone in the arterial tree. Rapid injection of large volumes and occlusion of the main artery by tourniquet will permit the high ascent of thiopentone into the main vessel of the arm, namely the brachial artery. Similarly the brachial artery is more readily involved if the injection is given into the medial aspect of the cubital fossa. Thrombosis of the brachial artery commonly results in amputation of the forearm.

The thrombosis occluding the arterial lumen may be complete within a few hours. Alternatively thrombosis may progressively encroach inwards from the intima leaving a narrow channel which in time may suddenly become occluded. This may account for the persistence of a pulse in some cases for as long as fourteen days after the incident before gangrene sets in.

CLINICAL FEATURES

Agonizing pain, described as burning or scalding, spreading down the forearm into the hand immediately follows intra-arterial injection of as little as 2 ml. of 5 per cent solution of thiopentone. This pain is the most constant feature and is rarely absent.

Onset of anaesthesia is delayed and its duration transient.

Pallor of the hand follows an initial red flush. This pallor may be associated with spasm of the vessels and so may persist on and off for days. Associated with the pallor is a lowering of skin temperature, both being an index of the impaired circulation. Occasionally cyanosis of the tips of the fingers or the nail beds is present.

The radial and ulnar pulse persist in most cases and may only be absent after a period of hours or days.

Mottled blue skin patches are commonly seen within a few hours distributed above and below the site of injection.

Oedema of the forearm occurs in about ten per cent of cases. It is possibly due to thiopentone entering the vascular muscle bed. (Fuhrman, 1951) and may be associated with flexion of the fingers.
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*Gangrene* will develop in the ischaemic areas should the condition fail to respond to treatment.

**TREATMENT**

The treatment aims at immediate dilution of the thiopentone, reduction of local spasm, general vasodilation of the limb, and anticoagulant therapy.

5 ml. of 2 per cent procaine or lignocaine are injected immediately, preferably through the needle left in situ, into the affected artery. The most successful results have been associated with this procedure (Culbert, 1954; Rollason, 1950; Swerdlow, 1954).

*Procede with general anaesthesia* to reduce sympathetic tone in the arm (Abramson, 1944). Deep anaesthesia causing fall of blood pressure and cardiac output should be avoided. It is interesting to note that this accident has not been observed in a case already anesthetized.

*Brachial plexus block* should be carried out and repeated at intervals particularly if pallor due to spasm is present. This may be necessary up to fifteen days in difficult cases. Alternatively stellate ganglion block may be used. Lignocaine 1 per cent has the advantage of rapid action but cinchocaine 1/1,500 is useful for its long-lasting action.

*Full heparinization* is desirable but can only be given if no operation is performed. A large initial dose of 15,000 units is given intravenously (Cohen, 1948) followed by a maintenance dose either by a continuous intravenous drip or four-hourly intramuscularly by injection to prolong the clotting time to the region of fifteen to twenty minutes. It is advisable to continue the administration for several days as long as there is danger of intra-arterial thrombosis.

Should operation be imperative, it must be decided whether the benefits of reduced thrombosis in the arm following the use of heparin outweigh the risk of uncontrollable haemorrhage (Medico-Legal, 1954), even although this may be minimized by careful surgical attention to the bleeding points. It is useful to remember that 1 mg of protamine sulphate neutralizes 100 units of heparin.

*Reflex heating.* By heating the other limbs, reflex vasodilatation results in the affected limb which should not in itself be heated. The patient should be given hot drinks and kept as warm as is comfortable.

*Drugs causing vasodilatation,* such as papaverine 40 mg in 20 ml saline, or tolazoline (Priscol) 50 mg in 5 ml saline, may be given into the affected artery or the subclavian artery with great effect (Dundee, 1953; Edwards et al., 1952; Woolmer, 1953). Tolazoline may be given orally 25 mg six-hourly. Morphine or preferably pethidine reduces vasoconstriction due to pain.

*Direct surgical treatment of the arterial lesion* has been extremely disappointing. Operations such as arteriectomy are of dubious value. Early arteriotomy with the hope of recanalization may be worth while (Van der Post, 1942), but as yet has had only slight success. Late surgery is hopeless.

*Care of the affected limb.* The limb is wrapped in a sterile towel and covered with cotton wool. It should neither be cooled nor heated and should be kept under observation for colour, temperature and pulse.

**PREVENTION**

The use of a more dilute solution of thiopentone, e.g. 2½ per cent, may reduce the severity of such an accident. It is interesting to note that of the 9 cases of gangrene, 6 were produced by a 10 per cent solution, 3 by a 5 per cent solution and none by a 2½ per cent solution as yet recorded. If veins are difficult to find, especially in shocked cases or in children, a 2½ per cent solution would seem to be the solution of choice.

*The site of injection.* It is preferable to avoid areas containing major arteries such as the medial aspect of the cubital fossa, as accidents are more

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*Fig. 1* Distribution of Recorded Accidents.
common and have more serious consequences in these areas (fig. 1). Even the lateral aspect of the cubital fossa and the lateral aspect above the wrist are not entirely immune (Fell, 1953). The back of the hand contains no superficial arteries and in difficult cases should be the site of choice.

Selection of the vein. The vessel should be palpated before the tourniquet is applied, since the tourniquet may prevent appreciation of any impulse in the vessel. In shocked cases pulsation may be too feeble to decide.

Method of injection. If the needle is first inserted without the syringe being attached, it may be possible to recognize bright arterial blood which may spurt if the tourniquet is correctly applied and the needle used is not too small, e.g. No. 12–14 hyp. In shocked cases hypotension and stasis invalidate this sign.

A test dose of 2 ml of 5 per cent thiopentone is given with tourniquet released, followed by a pause, and the patient is then asked if he feels any pain (Macintosh and Heyworth, 1943). In a fit adult 1 ml may be inadequate to produce this response.

CONCLUSION

This accident may suddenly face the anaesthetist at any time without warning. Constant vigilance and adherence to a technique involving routine precautions should do much to lessen its incidence.

Certainly in difficult cases such as young children and shocked patients, if thiopentone is used it would seem advisable to use a 2½ per cent solution given into the back of the hand.

Should the accident unfortunately occur, immediate treatment gives the best chance of mitigating its consequences.

REFERENCES


UNIVERSITY OF CAMBRIDGE

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