

## Intravenous Regional Anesthesia of the Upper Extremity

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Of the various techniques used to obtain regional anesthesia of the upper extremity,<sup>1</sup> the axillary perivascular technique as first described by Burnham in 1958<sup>2</sup> has achieved increasing popularity by virtue of its simplicity and low incidence of complications as compared with the supraclavicular approach to the brachial plexus. Recently, methods which are technically even more simple have been introduced whereby regional anesthesia of the upper extremity is produced following the intravascular injection of local anesthetic drugs. One such technique involves the intravascular injection of relatively large doses of lidocaine (40 ml. of 0.5 per cent lidocaine) into an arm which has been previously exsanguinated.<sup>3,4</sup> Regional anesthesia has also been obtained in the upper extremity following the intravascular injection of local anesthetics into the arm without prior exsanguination.<sup>5</sup> The disadvantages of the former technique<sup>3,4</sup> are related to the large doses of local anesthetic agent used, with the possible resultant toxic effects of such large doses. The disadvantages of the latter technique<sup>5</sup> are related to the lack of a bloodless field which is desired for many surgical procedures. Also, the anesthesia may prove inadequate in intensity and duration. The latter is probably related to hemodilution of the local anesthetic drug.

The present communication describes a method of producing regional anesthesia of the upper extremity by intravascular administration of local anesthetics in a technique that has proven advantageous over methods already described. It results in a more profound anesthesia, a bloodless operative field, and relatively small doses of local anesthetic are employed, thus providing a greater margin of safety, and a lesser incidence of toxic reactions.

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### METHODS

A small bore scalp vein needle is first inserted into a vein as close to the side of surgery or manipulation as possible. The arm is then exsanguinated with an Esmarch rubber bandage applied over the needle; a pneumatic tourniquet is applied to the upper arm and inflated above arterial pressure. The Esmarch bandage is then removed and lidocaine (Xylocaine) 0.5 per cent injected into the previously placed scalp vein needle in a dose of 1.5 mg./kg. of body weight. Onset of anesthesia is rapid and complete in a few minutes. A second pneumatic tourniquet is placed on the upper arm below the first, but not inflated at this time. At the first indication of tourniquet discomfort, the second tourniquet is inflated, and the initial one removed. At this point the tissues under the second tourniquet have already become infiltrated with lidocaine, hence tourniquet pain from this second tourniquet is not a problem. Supplementary narcotic, tranquilizer, or barbiturate sedation is administered in small doses on occasion, to control restlessness and apprehension. Sedation to the point of somnolence is seldom used.

At the conclusion of the procedure the tourniquet is removed. Return of sensation is rapid, becoming complete within a few minutes. No untoward effects were noted after removal of the tourniquet.

### RESULTS

This method has been used on 23 occasions. The anesthesia obtained was satisfactory in all instances. Duration of anesthesia ranged from 15 to 130 minutes. Anesthesia showed no signs of wearing off in any of the cases at the time the procedure was completed. The age of the patients ranged from 7 to 66 years. The operative procedures performed included elective skin, tendon and peripheral nerve surgery, as well as treatment of emergency soft tissue injuries and fractures of the hand and forearm.

## DISCUSSION

Foldes<sup>6</sup> has reported intravenous administration of lidocaine without the barrier of a tourniquet in an evaluation of the toxicity of intravenous local anesthetic agents. He noted minimal systemic symptoms at a dose of 1.4 mg./kg. administered over a 2.8 minute period. Significant symptoms were not noted until a dose of 6.4 mg./kg. was administered over a 12.8 minute period. This appears to attest the safety of our 1.5 mg./kg. dosage, especially when used with an occlusive tourniquet as noted.

This technique is contraindicated in instances where the extremity cannot be adequately exsanguinated with safety (*i.e.*, a large, fluctuant abscess which may rupture on application of the Esmarch bandage) and also in extensive soft tissue injury where a large amount of the anesthetic agent may be lost from the vascular system.

## SUMMARY

A satisfactory but simple method of producing regional anesthesia of the upper extremity

is described. The dose-weight relation noted makes this method useful in patients of all ages and sizes. This method appears to be safe, and superior to other similar techniques previously described.

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## Methoxyflurane Solubility in Plastics

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Methoxyflurane gradients between end-expired gas and arterial blood were reported recently by Holaday and associates (*ANESTHESIOLOGY* 26: 251, 1965). They sampled end-expired gas through a polyethylene catheter placed near the distal end of an endotracheal tube. A high solubility of methoxyflurane in polyethylene might affect the gradients by: (1) removal of methoxyflurane from end-expired gas and/or (2) contamination of end-expired methoxyflurane from a "leak" of higher inspired tensions through the catheter wall. Depending on which mechanism predominated, any end-expired arterial gradient would be (1) decreased or (2) increased. We, there-

fore, determined the solubility of methoxyflurane in polyethylene. The technique uses an infrared halothane analyzer to measure methoxyflurane concentrations and has been described previously (*ANESTHESIOLOGY* 23: 349, 1962). A polyethylene/gas partition coefficient of  $118 \pm 7$  was determined.

We also determined the solubility of methoxyflurane in nylon. Using the same technique, a nylon/gas partition coefficient of  $3.6 \pm 0.2$  was obtained. However, when polyethylene and nylon catheters were compared in actual end-expired sampling, no differences in methoxyflurane tensions could be demonstrated. Nonetheless, to assure accurate sampling, we believe that nylon is a much more appropriate material for conduction of methoxyflurane gas samples for analysis.

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