TITLE: RELATIVE LIDOCAINE AND BUPIVACAINE TOXICITY IN VENTILATED CATS

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INTRODUCTION: Reports of difficult and prolonged resuscitation attempts following inadvertent intravascular injections of potent amide local anesthetics, such as bupivacaine, have raised the question of whether such agents have greater cardiovascular toxicity than more traditional agents such as lidocaine.[1] Results of recent animal studies have indicated that the mean lethal dose of bupivacaine reflects its anesthetic potency and therefore is not more toxic to the cardiovascular system than lidocaine.[2] However, the margin of safety between central nervous system (CNS) and cardiovascular (CV) toxicity following rapid intravascular injection of these agents, as well as the question of difficulty of resuscitation, have not been answered experimentally.

METHODS: Twenty cats weighing 3.4 ± 0.4 (SD) kg had femoral arterial and right atrial (RA) catheters placed under halothane/N_2O/O_2 endotracheal anesthesia and pancuronium relaxation. Mechanical ventilation was adjusted to obtain normal blood gases. At least 20 min prior to drug infusion, halothane was discontinued and analgesia maintained with 70% N_2O in O_2. Since the commonly accepted potency ratio for bupivacaine to lidocaine is 4:1,[3] lidocaine 2% at 16 mg/kg/min (n = 10) or bupivacaine 0.5% at 4 mg/kg/min (n = 10) was infused into the RA. The first occurrence of EEG spike activity was taken as the CNS toxic endpoint. Drug infusion continued until mean arterial pressure (MAP) had decreased to 10 mm Hg (CV endpoint). Following 3 min of nonintervention (except for continued ventilation), resuscitation was begun with 100% O_2, closed chest cardiac compression, i.v. epinephrine, calcium chloride, and sodium bicarbonate on a fixed dosage schedule. When necessary, DC cardioversion (15-20 joules) was also used. The resuscitation endpoint was arbitrarily defined as a spontaneous MAP of 100 mm Hg.

RESULTS: EEG spike activity began at 0.8 ± 0.5 (SD) min following the start of drug infusion in the lidocaine group and 1.1 ± 0.3 min in the bupivacaine group (NS). The CV endpoint was reached at 3.0 ± 0.6 min in the lidocaine group compared to 4.9 ± 1.3 min in the bupivacaine animals ($p < 0.005$). Following progressive conduction abnormalities, which began earlier in the bupivacaine group, all animals became asystolic. Toxic doses are given in the following table:

CNS and CV Toxic Doses (mg/kg)

	CNS	CV	
Lidocaine	17.7 ± 4.6	46.4 ± 8.6	
Bupivacaine	3.8 ± 1.0	18.4 ± 4.9	(mean ± SD)

All 10 lidocaine animals were successfully resuscitated compared to 8 of 10 in the bupivacaine group (NS). Mean time to resuscitation was 4.4 ± 3.0 min for the lidocaine animals and 5.4 ± 2.4 min for the bupivacaine group (NS).

DISCUSSION: In this study using lightly anesthetized, ventilated animals and rapid drug infusion rates, CNS toxicity was found to parallel anesthetic potency. However, the margin of safety between CNS toxicity and CV collapse was significantly greater for bupivacaine than for lidocaine. It does not seem to be appreciably more difficult to resuscitate cats from cardiac arrest induced by bupivacaine than from lidocaine induced arrest.

REFERENCES:

1. Albright GA: Cardiac arrest following regional anesthesia with etidocaine or bupivacaine (Editorial). Anesthesiology 51:285-287, 1979

2. Liu P, Feldman H, Cavino BG: Acute cardiovascular toxicity of lidocaine, bupivacaine, and etidocaine in anesthetized ventilated dogs (Abstract). Anesthesiology 53:S231, 1980

3. Covino BG, Vassalo HG: Local Anesthetics: Mechanisms of Action and Clinical Use. New York, Grune and Stratton, 1976, p 46

[Supported in part by a grant from the American Society of Anesthesiologists]