Title : THE EFFECT OF SUBARACHNOID EPINEPHRINE ON SPINAL CORD BLOOD FLOW

Authors : A. Michael de Rosayro, F.F.A.R.C.S., Alan R. Tait, B.Sc., Dale Tuttle, B.S., and P. R. Knight, III, M.D., Ph.D.

Affiliation : Department of Anesthesiology, The University of Michigan Medical Center, Ann Arbor, MI 48109

INTRODUCTION. In a previous study of spinal cord blood flow (SCBF) using radioactive microspheres in dogs we demonstrated no changes following the administration of subarachnoid (SA) lidocaine with or without 1:200,000 epinephrine (EPI).[1] Usubiaga et al.[2] presented preliminary results suggesting a 48% reduction in SCBF in normocarbic and normothermic dogs following epidural and SA EPI using the Xenon washout technique. The presence of lidocaine could alter the vascular response induced by EPI. We, therefore, designed this study to assess the effects of EPI alone in the SA space using the microsphere technique. This allows us to study the entire spinal cord instead of a discrete site as in the Xenon washout technique.

METHOD. Twenty dogs were used in this study. Anesthesia was induced with pentobarbital and following endotracheal intubation, ventilation was controlled to maintain blood gases constant at PaO_2 between 110-130 torr; $PaCO_2$, 37-40 torr; and pH 7.35-7.38. The following vessels were cannulated: both femoral arteries, carotid artery and femoral veins. A Swan Ganz catheter was introduced via the external jugular vein. Following thoracotomy the left atrium was cannulated and the chest closed. Hemodynamic parameters including heart rate (HR), arterial pressure (AP), pulmonary capillary wedge pressure (PCWP), and central venous pressure (CVP) were recorded continuously on a Gould recorder. Cardiac output (CO) was determined at the times noted. Core temperature was also monitored and maintained at normothermia. Radiolabeled microspheres were injected into the left atrium at the following times: 1) control conditions, 2) 5 min after spinal injection of 10 cc of 1:200,000 EPI in saline, and 3) 15 min following spinal injection. At this time, blood samples were withdrawn simultaneously from the carotid and femoral arteries to serve as reference sample counts in the microsphere technique. Following this the animal was sacrified and necropsied. The spinal cord was removed and separated into three sections: thoracic, lumbar, and cauda equina. The left and right kidneys were sectioned to evaluate bilateral flow. All tissue samples and bloods were counted in a Beckman scintillation counter. The raw data was put in punched tape and radioactivity converted to blood flow values using a computer program. All results were analyzed using paired Student's t test.

RESULTS. As shown in the table, there were no significant hemodynamic changes following spinal injection of 50 µg of EPI. Blood gases, $PaCO_2$ in particular, were not significantly altered. There was no change in renal blood flow. SCBF in all 3 sections of the cord was reduced at 5 min after injection with the greatest reduction being in the cauda equina. When the individual regional flows are calculated as a percentage of total flow (cardiac output) the reduction is greater. Blood flow in all 3 sections returned to near control values at 15 min following injection.

DISCUSSION. Our results demonstrate a transient decrease in SCBF following 50 µg of spinal EPI, reaching approximately 50% in the cauda equina, which was the site of the subarachnoid injection. The decreases in flow in thoracic and lumbar cord were of a lesser magnitude and also returned to normal levels within 15 min. Usubiaga et al. demonstrated a similar fall in SCBF but stated that this persisted for up to 70 min.[2] However, the Xenon washout technique used in their study requires a laminectomy and direct injection in the cord. In addition, they employed doses of 100-150 µg of EPI which are 2-3 times greater than the dose injected in this study. It would appear, therefore, that the response of SCBF to EPI is dose related and is also modified by the presence of lidocaine. As the volume of spinal fluid in dogs is less than 1/10 of that in humans, 50 µg would represent a relatively large dose. It is unlikely therefore that doses of 100 µg or less which are conventionally used in clinical practice, especially in the presence of local anesthetics, would produce deleterious effects in humans.

REFERENCES.

1. de Rosayro AM, Tait AR, LaBond V, Ketcham TR, Knight PR: The effect of subarachnoid lidocaine and epinephrine on spinal cord blood flow. Anesthesiology 59:A208, 1983

2. Usubiaga JE, Gollan F, Yannakakis Z, Johnson A: The effect of epidural and subarachnoid epinephrine upon spinal cord blood flow. Proc ASA Meeting, San Francisco, 1969, p 57

	CONTROL	5 MIN AFTER EPI	15 MIN AFTER EPI
Heart Rate (beats/min)	152 ± 6	154 ± 5	147 ± 6
Mean AP (torr)	99.7 ± 4.4	100.2 ± 4.6	97 ± 4.7
PCWP (torr)	6.7 ± .39	6.5 ± .41	6.3 ± .41
CO (ml/min)	2634 ± 212	2788 ± 447	2789 ± 248
$PaCO_2$ (torr)	37 ± .46	39 ± .56	38 ± .66
BLOOD FLOWS (ml/min/100 g)			
Average Kidney Flow	327 ± 43	272 ± 32	296 ± 29
Thoracic Cord	25 ± 5.78	14 ± 2.5*	20 ± 2.75
Lumbar Cord	25 ± 4.11	17 ± 1.69	23 ± 2.32
Cauda Equina	35 ± 5.83	18 ± 1.96*	22 ± 1.73

* significantly different from control ($p < 0.05$)
All values are Means ± S.E.