Date :

Title : PROPRANOLOL DECREASES VASODILATOR-INDUCED INTRACRANIAL HYPERTENSION

Authors : F.M. deBros, M.D., N.T. Zervas, M.D.

Affiliation: From the Anesthesia and Neurosurgical Services of the Massachusetts General Hospital and the Departments of Anaesthesia and Surgery, Harvard Medical School, Boston, Massachusetts 02114.

Introduction

Recently, propranolol has found increased use as a therapeutic modality for hemodynamic homeostasis during neurological surgery and intensive care. Propranolol blocks β_1 receptors in intracranial vessels, as well as β_2 receptors in the systemic vasculature. This could lead to increased cerebral vascular tone and resistance. Furthermore, in the presence of β-blockade, vasodilators have a more profound effect on BP. It is conceivable that both these mechanisms can be therapeutically useful to decrease BP without increasing intracranial pressure (ICP). The purpose of this study is to elucidate the validity of such a concept. Of particular interest is the question of whether β-blockade can prevent vasodilator-induced increases in ICP.

Methods

Six mongrel dogs were anesthetized with intravenous Brevital, intubated with succinylcholine (SCh), and ventilated for normoxemia and normocarbia. Anesthesia was maintained with fentanyl and a pancuronium/metocurine mixture. A thermodilution-tipped catheter was placed in wedge position into the pulmonary artery. Arterial and venous catheters were placed into the femoral vessels. A #8 Foley catheter was placed in the temporofrontal subdural space. After sealing the burrhole with methylmethacrylate, a #20 Jelco catheter was placed in the cysterna magna. Pressures were recorded via transducers. Student's *t* test for paired data was used for data analysis.

The study comprised four 90-minute periods. In period 1, BP was lowered stepwise with increments of an infusion of sodium nitroprusside (SNP). In period 2, after hemodynamic parameters had returned to normal, ICP was raised by inflating the epidural balloon in 0.5 cc increments until ICP remained consistently above 30 cm H_2O; SNP was then infused in incremental dosages until BP fell to 90 mm Hg. In period 3, the epidural balloon was deflated and 0.5 mg/kg propranolol administered over a 15-minute period; SNP was then infused in incremental dosages until BP fell to 90 mm Hg. In period 4, ICP was raised above 30 cm H_2O by inflating the epidural balloon, and BP was lowered with SNP to 90 mm Hg.

Results

Figure 1 shows: (1) SNP (35 µg/kg/min) increased ICP ($p<0.05$) from 18±5 (±SD) to 43±10 cm H_2O; (2) After β-blockade, SNP (35 µg/kg/min) increased ICP ($p<0.05$) from 24±5 to 37±5 cm H_2O; (3) With the mass lesion, SNP (35 µg/kg/min) increased ICP ($p<0.05$) from 31±5 to 55±15 cm H_2O; (4) With the mass lesion and after β-blockade, SNP (35 µg/kg/min) increased ICP from 34±6 to 44±6 cm H_2O, but not significantly. CO and HR significantly decreased after β-blockade, whereas PA and PCW rose significantly. β-blockade had no effect on BP and ICP. Reduction of cerebral perfusion pressure (CPP) was more pronounced with the combination SNP/propranolol than with SNP alone. Propranolol alone had no effect on CPP. Drugs used for anesthesia had no effect on BP, HR, and ICP.

Discussion

a) Hemodynamic Pressure: In the dog anesthetized with a balanced technique, large amounts of SNP (up to 50 µg/kg/min) are necessary to decrease BP below 100 mm Hg. However, after β-blockade, BP can be lowered with smaller amounts of SNP, e.g., in study period 3, only 2 of 6 preparations required more than 20 µg/kg/min to reach a BP below 100 mm Hg.

b) Intracranial Pressure: ICP values gradually increased toward the end of the study. This is attributed in part to a gradually decreased intracranial cerebral compliance (ICC), measured by injection of 0.1 cc normal saline into the subdural catheter. Although absolute ICP values (Figure 1) seem to be elevated after β-blockade, the net increase in ICP was less pronounced after β-blockade, especially in preparations with simulated intracranial space-occupying lesions. This effect could be a consequence of hemodynamic interactions of SNP and propranolol, but we cannot exclude a direct effect of propranolol on cerebral vessels.

c) Cerebral Perfusion Pressure: Although propranolol alone does not decrease CPP, it markedly potentiates SNP as a result of its hemodynamic effects.

Figure 1