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Title : INTRACRANIAL EFFECTS OF NITROGLYCERIN - AN OBSTETRICAL HAZARD?

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Introduction: Nitroglycerin (NTG) infusion decreases the pressor response to tracheal intubation in preeclamptic parturients receiving general anesthesia for Cesarean section (1). Since in gravid ewes NTG lessens norepinephrine (NE) induced uterine vasoconstriction (2), its use in pregnancy hypertension appears desirable. Because NTG increases intracranial pressure (ICP) in normotensive animals (3) we determined how NTG, used to counter NE induced hypertension, influenced the effects of NE on ICP.

Methods: 36 studies were performed on 11 dogs. After IM succinylcholine 3 mg/kg and atropine 0.4 mg, tracheal intubation was performed, the dog connected to a Harvard pump, and ventilation adjusted to produce mild hypocarbia ($PCO_2$ 33.7 ± 0.6 mm Hg). Nitrous oxide (N20) 66% + halothane (1.0 - 1.3%) was used to maintain anesthesia. Following percutaneous cannulation of a jugular vein and femoral artery we maintained relaxation with IV succinylcholine (0.1%), recorded blood pressure on a Grass polygraph and inserted a subarachnoid bolt in the left parietal area to monitor ICP. IV drugs were infused by Harvard syringe (NTG) or infusion pump (NE). There were four experiments:

Experiment 1: After infusing NE (0.58 ± 0.04 µg/kg) to increase mean arterial pressure (MAP) to 122 ± 4.2% of control, we administered NTG (39 ± 1 µg/kg) to restore MAP to control while recording ICP continuously.

Experiment 2: NTG was infused to decrease MAP to 89 ± 1.7% of control. NE was then added to restore control pressure.

Experiments 3 and 4: We repeated the above experiments after adding halothane to the anesthetic technique.

Order of experiments was randomized except that the two halothane (or non-halothane) experiments were performed consecutively. We allowed 20 mins to stabilize MAP and ICP before and after each experiment and 40 mins for uptake or elimination in the halothane experiments. Control was the stable value of MAP and ICP existing before each experiment.

Results: We confirmed that NTG increases ICP in normotensive N20 anesthetized dogs (Fig. 1). The increase is unrelated to the decrement in MAP.

When NTG is given to the NE hypertensive dog (N20 anesthesia) ICP, already elevated by NE to 13.5 ± 1.4 mm Hg, increases to 18 mm Hg (Fig. 2).

When NE is given to the NTG dog (N20) ICP, already elevated by NTG to 17 ± 1.9 mm Hg, remains unchanged (Fig. 1). After NE alone (Fig. 2) MAP in N20 dogs (171 ± 6.3 mm Hg) was associated with ICP of 13.5 ± 1.4 mm Hg. In contrast in all N20 dogs receiving NTG with NE, MAP was 143 ± 4 mm Hg and ICP 17 ± 1.4 mm Hg. We plotted the linear correlation between MAP and ICP (both expressed as percent control) and observed that NTG shifts the NE line to the left.

Administration of halothane decreased MAP. Infusing NE then raised ICP to 19.2 ± 3.6 mm Hg (161 ± 18.5% of control), a greater increase than N20 dogs (Fig. 2). Adding NTG further increased ICP to 22.1 ± 3.9 mm Hg. NTG alone increased ICP to 14 ± 1.3 mm Hg, less than in N20 dogs; but MAP fell to 81 ± 5 mm Hg, a greater decrement. When NE was added MAP increased to 145 ± 3.2 mm Hg (140 ± 7.5 control) and ICP increased markedly to 20 ± 2 mm Hg (Fig. 1).

Discussion: Our results suggest that NTG diminishes autoregulation of CBF as proposed by Ivankovich et al (4) increasing CBF despite reduced MAP. Any maneuver now increasing MAP (tracheal intubation) could significantly increase ICP. Experiment 4 (Fig. 1) mimics this situation - autoregulation is presumed disturbed by halothane and NTG, and NE significantly increases ICP. In contrast, in experiment 2, when autoregulation is presumed disturbed by NTG, NE increased MAP less and ICP was stable. Therefore, we might interpret the level of MAP to be important.

Although animal studies may not reflect human responses we recommend caution in giving NTG to hypertensive patients when intracranial dynamics may be disturbed (Fig. 2). We are concerned that prior administration of NTG to parturients with preeclampsia or intracranial aneurysm, might be detrimental if MAP subsequently increased abruptly (Fig. 1). Another approach to controlling MAP in preeclampsia may be desirable.

References:

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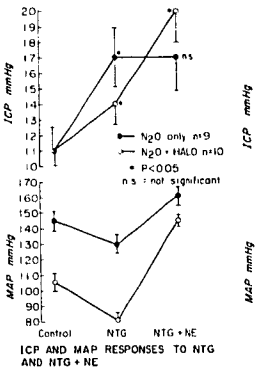
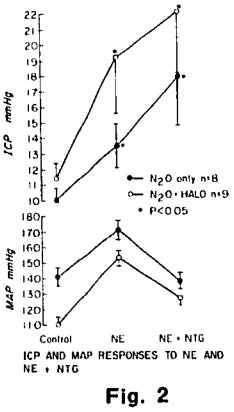



ICP AND MAP RESPONSES TO NTG AND NTG + NE

Fig. 1




ICP AND MAP RESPONSES TO NE AND NE + NTG

Fig. 2