Title: SPINAL SYMPATHETIC BLOCKADE DECREASES TOLERANCE TO HEMORRHAGE BY ATTENUATING COMPENSATORY RESPONSES TRANSMITTED VIA THE SPLANCHNIC NERVE.

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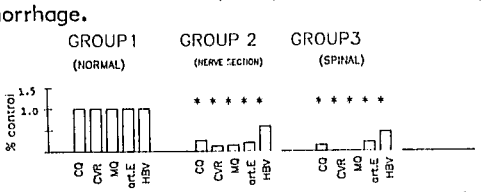
Introduction: Mongrel dogs were subjected to hemorrhagic hypotension in the presence or absence of bilateral splanchnic nerve section to evaluate whether decreases in capacitance vessel blood flow (CQ), increases in adrenal medullary blood flow (MQ), and increases in adrenal catecholamine secretion are compensatory responses to hemorrhage transmitted via the splanchnic nerve. To further elucidate splanchnic neuronal transmission, additional animals were subjected to repetitive electrical stimulations of the splanchnic nerve and given either adrenergic antagonists or no drugs. We hypothesized that the capacitance vessel and adrenal medullary changes which occur during hemorrhage are sympathetic responses that can be modified by alterations in splanchnic nerve transmission. To determine whether spinal sympathetic blockade produced by regional anesthesia significantly alters these responses to hemorrhage, animals were subjected to hemorrhagic hypotension in the presence or absence of spinal anesthesia. We hypothesized that regional anesthesia significantly decreases compensatory splanchnic responses to hemorrhage and increases cardiovascular lability during periods of acute blood loss.

Protocol: Twenty-four pentobarbital anesthetized, intubated, mechanically ventilated mongrel dogs were allocated to one of six groups. Using a pressurized bottle technigue, Group1 (n=4), Group2 (n=4), and Group3 (n=4) animals were hemorrhaged to a mean arterial blood pressure (MAP) of 60mmHg for 10 minutes by a withdrawal of an appropriate volume of blood. The hemorrhaged blood volume was then re-infused. Animals in Group1 served as the control group, while animals in Group2 were subjected to bilateral section of the splanchnic nerve trunk and animals in Group3 were given spinal anesthesia (35mg isobaric lidocaine). Subsequently, all three groups were again hemorrhaged to a MAP of 60mmHg. Prior to and 5 minutes into each hemorrhagic stimulus, the parameters of arterial norepinephrine (NE) and epinephrine (E) concentrations (measured by HPLC), MQ (radiolabelled microsphere technique), CQ (kidney, small bowel, large bowel, spleen, and pancreas blood flows), and hemorrhaged blood volume were determined.

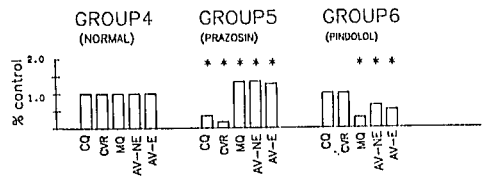
Animals in Group4 (n=4), Group5 (n=4), and Group6 (n=4) were subjected to 3 identical splanchnic nerve stimulations at 20hz, .5msec, 5volts, with a .8sec pause/second. Prior to the second and third nerve stimulation, Group4 animals received no drug, Group5 received prazosin (1mg/kg and 4mg/kg), and Group6 pindolol (1mg/kg and 4mg/kg), respectively. The parameters of adrenal venous NE and E concentrations, MQ, and CQ were determined prior to and 3min. into each nerve stimulation.

Statistical significance ($p < 0.05$) was determined by analysis of variance procedure for repeated measures using each animal as its own control.

Results: In response to hemorrhagic hypotension, Group1 animals (controls) revealed comparable decreases in blood flow and increases in resistance for each capacitance vessel organ studied. These animals also showed similar decreases in CQ (587±34 TO 247±30 ml/min/100gms), similar increases in capacitance vascular resistance (16±2 to 25±2.5 mmHg/ml/min/100gms), MQ (450 to 1181 ml/min/100gms), arterial E concentration (.5±.1 to 9.8 ng/ml), and similar hemorrhaged blood volumes for each hypotensive stimulus (680±50mls). Nerve section (Group2) or spinal anesthesia (Group3) reduced hemorrhaged blood volume and attenuated CQ, MQ, and arterial E responses to hemorrhage.



Three identical splanchnic nerve stimulations (Group4) elicited identical responses. CQ decreased 51%(572±19 to 284±10 ml/min/100gms), capasitance vessel resistance increased 3 fold(13±2 to 42±5 mmHg/ml/min/100gms), and adrenal venous NE and E secretion increased 370 fold and 224 fold (.5±1 to 185±5 and 8±.9 to 1792±68 ng/min, respectively). These responses mimicked the responses elicited by hemorrhagic hypotension. Prazosin (Group5) blocked the capacitance vessel response to nerve stimulation and accentuated adrenal medullary responses. Pindolol (Group6) blocked the adrenal medullary responses to nerve stimulation, but not the capasitance vessel response.



Conclusion: The present study demonstrates that: (1) decreases in capacitance vessel blood flow, increases in adrenal medullary blood flow, and increases in adrenal catecholamine secretion are compensatory responses to hemorrhage transmitted via the splanchnic nerve; (2) these responses increase tolerance to hemorrhage and help maintain homeostasis during episodes of acute blood loss; (3) these responses are attenuated by bilateral splanchnic nerve section and spinal anesthesia and can be elicited by electrical stimulation of the splanchnic nerve. The present data therefore suggests that responses to hemorrhage are sympathetically mediated and can be attenuated by the appropriate adrenergic antagonists. Consistant with this view, our data shows that the alpha-1 adrenergic receptor response, vasoconstriction, predominates in capacitance vessel organs, while the beta adrenergic receptor response, vasodilation and increased adrenal catecholamine secretion, predominates in the adrenal medulla. Thus, the reduced tolerance to blood loss which occurs during regional anesthesia is due to the attenuation of homeostatic splanchnic responses by spinal sympathetic blockade.

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