Hemodynamic Response to Brachiocephalic and Common Carotid Artery Occlusion[1] (36699)

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Recently, the effects of carotid sinus hypotension were investigated in a series of experiments on conscious dogs in which the blood flow to the carotid arteries was reduced by using an occlusion cuff around the brachiocephalic artery (1). This procedure was decided upon because it was found that the presence of cuffs around the common carotid arteries of nonanesthetized dogs resulted often in thrombosis of the vessels, most probably due to the movement of the neck. However, since one vertebral artery originates along with the two common carotid arteries from the brachiocephalic artery, some reduction in cerebral blood flow may result from brachiocephalic occlusion that would not have occurred with bilateral common carotid artery occlusion only. The purpose of this investigation is to determine whether this additional occlusion will cause the hemodynamic responses to brachiocephalic occlusion to differ significantly from those of carotid occlusion.

Methods. Ten dogs (six males and four females ranging from 12 to 24 kg) were used in these experiments. All dogs were sedated with morphine sulfate (1–2 mg/kg) followed by anesthesia with sodium pentobarbital (20 mg/kg). Additional amounts of anesthetic were given during the procedure as needed. The experimental procedure was performed while the dogs were anesthetized and at the end of the procedure the dogs were sacrificed.

Both common carotid arteries in the neck were isolated and fish line snares were secured around each artery. The vagi and the aortic depressor baroreceptor were left intact. A left sided thoracotomy was performed and a fish line snare was passed around the brachiocephalic artery at the aortic arch. Throughout the procedure, the thorax was open and breathing was assisted with a Harvard respirator. Statham or Micron flow probes were placed on both the ascending aorta and the femoral artery and aortic and femoral artery flows were measured using a Statham M-4000 blood flow meter. The contralateral femoral artery was catheterized and arterial blood pressure was monitored using a Statham pressure transducer. Heart rate was measured using a Clevite-Brush Biotachometer triggered by the dog's EKG. Data were recorded on either an Elema-Schonander Mingograph 91 or Beckman eight channel recorder.

The four variables monitored were arterial blood pressure, cardiac output minus coronary flow, femoral artery blood flow, and heart rate. All readings were taken simultaneously and continuously. The protocol followed was to perform at least five brachiocephalic occlusions and five carotid occlusions. The occlusions were done in an alternating fashion with a carotid occlusion always followed by a brachiocephalic occlusion and vice versa. Following the occlusion, lasting 60 seconds, readings were taken of the mean values of all variables after a steady-state had been reached. Upon release of the occlusion, the next occlusion was not attempted until all of the measured variables had reached steady-state values. The average time between occlusions was five minutes.

Results. A total of 135 occlusions were carried out on the 10 dogs used for this experiment. A summary of the mean values,

[1] This work was supported by the National Heart and Lung Institute Grant HE 12690-03.

TABLE I. Summary of Data.[a]

	Art. pressure (mm Hg)	Heart rate (beats/min)	Cardiac output (ml/min)	Femoral flow (ml/min)	TPR (mm Hg/liter/min)	HLR (mm Hg/liter/min)
Control ± SE	113.23 ± 1.83	164.17 ± 3.29	1426.90 ± 79.16	37.41 ± 3.51	91.99 ± 3.36	4.86 ± 0.28
Carotid artery occlusion ± SE	155.33 ± 4.41[b]	175.91 ± 4.52[b]	1726.70 ± 213.29	38.14 ± 5.87	131.17 ± 12.32[b]	6.77 ± 0.69[b]
Brachial artery occlusion ± SE	155.98 ± 5.06[b]	175.43 ± 4.30[b]	1725.41 ± 236.71	39.42 ± 5.26	129.53 ± 9.89[b]	6.56 ± 0.63[b]

[a] TPR = total peripheral resistance; HLR = hind limb vascular resistance. TPR value is equal to mean arterial blood pressure divided by cardiac output in liters per minute; HLR value is equal to mean arterial blood pressure divided by femoral flow in milliliters per minute.

[b] Difference from control value is statistically significant.

obtained for each dog, is shown in Table I. The overall means, obtained by pooling the data from all 10 dogs, is shown at the bottom of Table I. "Control" represents the mean values of the variables, at steady-state, just before occlusion.

The brachiocephalic and common carotid occlusion means, of each dog, for each of the six columns were paired and subtracted and both a one-tailed and a two-tailed t test was performed on each of the six sets of 10 differences. No significant difference between the values obtained by brachiocephalic artery or bilateral common carotid artery occlusion was demonstrated in any of the six paired t tests. The calculated values of t are shown in Table II.

The overall means for values obtained after both carotid and brachiocephalic artery occlusion were tested, using the t test, against the control means. Postocclusion arterial blood pressure, heart rate, hind limb vascular resistance, and total peripheral resistance means were found to be significantly greater than control mean values at the $p < .05$ level of significance. Cardiac output and femoral artery flow mean values, after occlusion, were found not to differ significantly from control mean values at $p < 0.05$ level of significance.

Discussion. It is well established, in the dog, that a great reduction in cerebral blood flow can, by itself, through direct action on the vasomotor center in the medulla, produce a systemic hypertension (2–6). However, in these investigations, a rather radical reduction in cerebral blood flow was found to be necessary before a rise in systemic pressure was noted. These reports and other anatomical investigations (7, 8) indicate the existence of extensive collaterals in the cerebral circulation of the dog and that it is difficult to seriously compromise the cerebral blood flow in the dog by anything but the most radical of procedures.

The results of this investigation show that there is no significant difference in the hemodynamic response (based on the six variables monitored) due to carotid sinus hypotension whether produced by a bilateral occlusion of the common carotid arteries or by an

TABLE II. Calculated Values of t and Critical Value at $p = .05$.[a]

Blood pressure	Heart rate	Cardiac output	Femoral flow	TPR	HLR	Critical value of t with $df = 9$
1.07	1.40	—0.59	0.68	—0.451	—1.69	One tail 2.26
NS	NS	NS	NS	NS	NS	Two tail 1.83

[a] df = degrees of freedom; NS = nonsignificant.

occlusion of the brachiocephalic artery.

Summary. Ten anesthetized dogs were used to compare the hemodynamic responses to bilateral common carotid occlusion with that produced by occlusion of the brachiocephalic artery. Arterial blood pressure, heart rate, cardiac output minus coronary flow, femoral artery flow, total peripheral resistance, and hind limb vascular resistance were measured following occlusion of both common carotid arteries and following occlusion of the brachiocephalic artery. The mean values obtained for these six variables were compared using a paired t test. No significant difference was demonstrated between the values obtained using these two different experimental procedures for producing endosinusal hypotension. It can be concluded that the occlusion of the brachiocephalic artery may be used in experiments in which endosinusal hypotension has to be produced but where the occlusion of the common carotid arteries becomes impractical.

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Received April 24, 1972. P.S.E.B.M., 1972, Vol. 140.