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Hemodynamics Following Experimental Coronary Occlusion in Dogs.*

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After a series of preliminary studies on dogs, a technique was instituted with which it was possible to carry out, within a period of approximately 30 minutes, a variety of experimental procedures which reflect the hemodynamics of the circulation under various conditions. The following factors were studied: cardiac output, total blood volume, venous and arterial pressure, ether and cyanide circulation time, hemoglobin percentage, erythrocyte count, serum proteins, pulse rate and temperature. Table I lists the findings in the following 5 groups of dogs, each group representing 10 animals:

1. Anesthesia controls. In this group, studies were made 15 minutes after the administration of anesthesia and one-half hour later.

2. Thoracotomy controls. In this group, thoracotomy was performed under anesthesia, the pericardium was opened and the left anterior descending coronary branch was dissected but not tied. The hemodynamic studies were made immediately before the thoracotomy and immediately after closing the chest.

3. Sudden left anterior descending coronary branch ligation. In this group, hemodynamic studies were made under anesthesia immediately before the thoracotomy and vessel ligation and immediately after closure of the chest.

4. Double carrick-bend controls. In this group, a special knot (double carrick-bend) was placed around some relatively avascular left ventricular muscle near the left anterior descending coronary branch. The threads from the knot were led out at opposite points in the chest wall. One week later, these muscle fibers were ligated by traction on the threads from the exterior of the chest. Studies were done under anesthesia before and after this control ligation.

5. Double carrick-bend left anterior descending coronary branch ligation. In this group, the knot was placed around the artery. One week later, hemodynamic studies were made under anesthesia

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before and after occlusion of the vessel by traction on the threads emerging from the chest.

TABLE I.
Average Immediate Changes in the Circulatory Dynamics Following Various Procedures under Anesthesia.

Procedure:		1. Anesthesia Controls	2. Thoracotomy Controls	3. L.A.D. Coronary Branch Ligations	4. Double Carrick-Bend Controls	5. Double Carrick-Bend L.A.D. Coronary Branch Ligations
Cardiac Output:	Pre.*	100	100	100	100	100
% changes per	Post.*	86	82	52	83	56
sq. meter	Diff.	—14	—18	—48	—17	—44
Total Blood Vol.:	Pre.	100	100	100	100	100
% changes per	Post.	98	92	96	96	89
sq. meter	Diff.	—2	—8	—4	—4	—11
Arterial Blood	Pre.	123	142	146	122	118
Pressure: mm.	Post.	125	121	117	120	120
of mercury	Diff.	+2	—21	—29	—2	+2
Venous Pressure:	Pre.	3.0	2.3	2.7	1.8	1.3
cm. of water	Post.	2.7	1.8	2.0	2.0	1.3
	Diff.	—0.3	—0.5	—0.7	+0.2	0
Ether Circulation	Pre.	4.6	3.4	4.7	4.6	4.3
Time: sec.	Post.	4.1	4.9	5.2	5.2	5.2
	Diff.	—0.5	+1.5	+1.5	+0.6	+0.9
Cyanide Circulation Time: sec.	Pre.	7.6	8.8	9.2	11.1	8.7
	Post.	8.0	11.1	14.8	11.6	12.8
	Diff.	+0.4	+2.3	+5.6	+0.5	+4.1
% Hemoglobin	Pre.	77	87	81	82	71
	Post.	81	90	82	83	74
	Diff.	+4	+3	+1	+1	+3
Erythrocyte count	Pre.	6.31	5.95	5.88	6.32	5.53
in millions per	Post.	6.85	6.40	5.82	6.41	6.21
cu.mm.	Diff.	+0.54	+0.45	—0.06	+0.09	+0.68
Total Serum	Pre.	5.65	6.39	5.91	5.07	5.18
Proteins	Post.	5.63	6.51	6.17	4.99	5.25
	Diff.	—0.02	+0.12	+0.26	—0.08	+0.07
Pulse Rate per	Pre.	161	187	176	168	180
min.	Post.	167	159	152	168	155
	Diff.	+6	—28	—24	0	—25
Temperature (F)	Pre.	101.7	100.9	99.8	101.8	99.5
	Post.	101.0	100.7	98.7	101.3	97.7
	Diff.	—0.7	—0.2	—1.1	—0.5	—1.8

*Pre. and Post. refer to pre- and post-operative procedures in groups 2 and 3. In group 1 studies were made 15 and 45 min. respectively after induction of anesthesia. In groups 4 and 5 they were made before and after ligation of the muscle or artery.

As can be seen from the table, a significant immediate change following the respective procedures using the anesthesia control group as a baseline, was a fall in the average cardiac output after ligation of the left anterior descending coronary branch both in the open chest as well as in the closed chest (double carrick-bend). Whereas the other control groups also showed a diminution in the average cardiac output, this diminution was considerably smaller than in animals in which coronary ligation had been performed. The only other significant change was a prolongation of cyanide circulation time in both groups in which coronary branch ligation was done.

Fluctuations in arterial blood pressure were considerable. However, a relatively small fall in the average arterial blood pressure occurred only in those groups in which the chest had been opened. Since this also took place in the thoracotomy control group, the fall in blood pressure could not be attributed to the coronary branch ligation. No appreciable differences were found in venous blood pressure. The total blood volume, ether circulation time, hemoglobin percentage, erythrocyte count and total serum protein showed insignificant changes. There was a moderate slowing in pulse rate in the open chest operations as well as in the double carrick-bend ligations. This, however, was insufficient to account for the change in cardiac output. There was apparently some relation between the drop in temperature and the decreased cardiac output.

Conclusion. Following left anterior descending coronary branch ligation in the open or closed chest there is an immediate appreciable fall in average cardiac output and also a delay in cyanide circulation time. Control experiments indicate that these changes are directly attributable to the ligation of the coronary branch. Following these procedures there are no other appreciable changes in the hemodynamics studied.