period the collections and replacements of the digestive secretions were made in the usual manner. Then the isolated loop was closed by plugging the drainage cannula with cotton and screwing a cap on the end. In 2 of these animals there was leakage around the cannula which allowed the loop to decompress and prevented strangulation. However, in 2 animals the closure was perfect. The loops became distended, necrotic, and perforated as revealed at autopsy. During the control period the secretions in these 2 animals averaged about 65 cc. per hour, whereas the highest value after obstruction of the loop was 50 cc. per hour. Often it was much lower. One animal showed a sharp terminal rise in secretion, which, however, did not exceed the average for the control period. The character and amount of the immediately preceding secretions indicated this probably was due to terminal relaxation of the pylorus and emptying of accumulated fluid in the stomach rather than to stimulation. In the second dog the stomach was aspirated frequently during the period of obstruction and the terminal rise did not occur. It is our belief, therefore, that in isolated duodeno-jejunal loop strangulation obstruction the combined gastric, pancreatic, biliary and upper duodenal secretions are not stimulated to excessive secretion. On the contrary they tend to be depressed.

7605

Embolism by Air and Oxygen: Comparative Studies.*

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Attempts were made in these experiments to compare the minimal fatal dose of air and oxygen when introduced into a peripheral vein. Van Allen, Hrdina and Clarke[1] found that in embolism due to air introduced into the pulmonary vein, the rapidity of introduction of the air and the position of the animal were 2 factors of prime importance. The position of the animal was believed to be of importance by directing the flow of air upward by gravity. These authors found that when the head was uppermost, the air more easily pro-

* Work done in part under a grant from the Douglas Smith Foundation. Preliminary report.

[1] Van Allen, C. M., Hrdina, L. S., and Clarke, J., *Arch. Surg.*, 1929, **19**, 567

duced death. In embolism due to introduction of air into a peripheral vein, the air goes first to the heart and lungs independent of the position of the animal. In the present studies, all animals were kept flat in the supine position during the injection of gas. The gas was injected quite rapidly; in most instances the entire amount being introduced in about 30 seconds.

The minimal fatal dose of air was found to be about 8 cc. per kilo body weight. Animals under urethane anesthesia were used throughout the work. The air was injected through a large cannula into the femoral vein (usually the left) from an inverted burette, being forced in by a column of water. Another cannula was placed in the carotid artery to record the blood pressure. The air flowed in rapidly until at a certain point it began to flow more slowly and the column of water showed pulsations synchronous with the heart beat. This usually occurred when very roughly nine-tenths of the minimal fatal dose was injected. The results of 11 air injections are shown in Table 1.

TABLE I.
Effects of Injection of Air into the Femoral Vein.

No.	Dog Wt. Kg.	Cc. air injected	Cc. per Kg.	Time of injection sec.	Result
1	6.5	150	23.1	960	death
2	7.0	55	7.9	205	"
3	9.0	45	5.0	7	"
4	9.5	47	5.0	75	recovery
5a	8.0	54	6.8	10	"
5b	8.0	64	8.0	10	death
6	8.5	68	8.0	22	"
7	12.0	68	5.7	38	recovery
8	12.0	72	6.0	32	death
9	6.9	64	9.3	16	"
10	7.0	56	8.0	18	"
11	19.0	178	9.4	40	"

A dog that recovered following an injection of air or oxygen usually showed a rapid fall in blood pressure to as low as 20 mm. of mercury with gradual recovery to the normal level. There was usually no diminution in pulse pressure, but some slowing of the heart rate. Necropsy shortly after recovery in one dog showed no air or oxygen in the heart. Recovery was usually complete within 2 or 3 minutes.

A dog that died following an injection of air or oxygen usually showed a rapid fall in blood pressure to about 16 mm. of mercury with no return to the normal level. There was a rapid decrease in the pulse pressure with some slowing of the heart rate. The pulse

became imperceptible to palpation and on the blood pressure tracing. However, as long as 3 minutes after the last visible cardiac pulsations, a few abortive respirations would occur. In some cases a few weak cardiac pulsations occurred as long as 8 minutes after death as seen when the chest was opened. Necropsy showed air or oxygen in the vena cava and right side of the heart.

Oxygen injections were only slightly less toxic than air injections as seen in Table II. All effects on the blood pressure, respiration, and pulse were identical.

TABLE II.
Effects of Injection of Oxygen into the Femoral Vein.

No.	Dog Wt. Kg.	Cc. air injected	Cc. per Kg.	Time of injection sec.	Result
12a	7.8	62	8.0	20	recovery
12b	7.8	62	8.0	22	"
12c	7.8	69	8.9	26	"
12d	7.8	78	10.0	37	"
13a	9.5	65	6.8	30	"
13b	9.5	76	8.0	25	death
14	9.5	75	7.9	35	"
15	8.0	72	9.0	38	"
16	6.5	72	11.0	28	"
17	7.5	75	10.0	33	"
18a	8.0	80	10.0	30	recovery
18b	8.0	100	12.5	22	death

In an 8 kg. dog there is about 615 cc. of blood (assuming one-thirteenth of the body weight is blood). The arterial blood may be considered to be completely saturated with oxygen. Then assuming that half of the blood in the body is venous and that this half is 6% unsaturated with oxygen (it is realized that the unsaturation depends on vasomotor conditions and varies in various parts of the body), then the blood of the entire body of an 8 kg. dog is 0.06 x 308 = 19 cc. unsaturated. Since air is about 20% oxygen, and the minimal fatal dose of air for such a dog is 64 cc., this amount of air would contain 13 cc. oxygen. Thus the air would be taken up by the hemoglobin to the extent of 13 cc. while 19 cc. of oxygen might be taken up. Theoretically therefore, from the standpoint of combining with hemoglobin, the 2 should act practically the same. It is quite possible that because of the rapidity of the injection, the oxygen or air does not have time to mix with all the venous blood. Except for this it might be expected that an 8 kg. dog could tolerate 19 cc. more air or oxygen than pure nitrogen.

An attempt was made in experiments 13b and 15 to increase the oxygen unsaturation by clamping off the trachea for 60 and 75

seconds respectively just before injecting the oxygen. It is seen that the oxygen tolerance was not increased by this procedure. No blood studies were made in these dogs.

Calculations are made that indicate that the minimal fatal dose of oxygen should not be greater than that of air when injected rapidly into the peripheral vein of a dog. The results of 24 injections of air or oxygen into 18 dogs show no marked difference in toxicity.

7606 C

Studies on Centrifuged Frog Eggs.

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The effect of centrifuging fertilized eggs of the frog both before cleavage and during the early cleavage stages has been studied by several investigators. Gurwitsch,[1] Hertwig,[2] Wetzel,[3] Morgan,[4] Konopocka,[5] McClendon,[6] and Jenkinson[7] particularly have reported the redistribution of certain materials and the intense stratification of others along the primary axis of centrifuged frog eggs. They state that the stratification of materials takes place in the order of their relative specific gravity, *i. e.*, a yellow or white centripetal layer, a translucent protoplasmic middle layer and a heavy yolk centrifugal layer containing the black pigment granules. In general, the results of these investigators show that, when the centrifuging has been relatively weak, development is often apparently normal with perhaps a slight abnormal pigmentation and distribution of fat in the head region. However, if the centrifugal force has been slightly greater, curious monsters often appear. Jenkinson particularly has noted that the myotomes and spinal ganglia are frequently fused together beneath the nerve tube and that the notochord is often absent altogether. Hertwig frequently obtained monstrosities of the spina bifida type. Pasquini and Reverberi[8] have centri-

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7 Jenkinson, J. W., *Quart. J. Micr. Sci.*, 1915, **60**, 61.

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