

EFFECT OF MORPHINE AND THIOPENTAL SODIUM-OXYGEN UPON CARDIOVASCULAR FUNCTIONS IN THE DOG

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THE cardiovascular effects of thiopental sodium-oxygen without pre-anesthetic agents have been reported (1, 2). The purpose of the present investigation was to determine the change in the above effects owing to the subcutaneous administration of morphine sulfate (3 mg./kg.) about 30 minutes before the injection of thiopental sodium.

METHOD

As soon as possible after the intravenous injection of thiopental, a tracheal cannula was inserted, and the dog attached to the anesthesia machine (Heidbrink, Kinet-O-Meter) by which a flow of oxygen of 100-200 cc./min. was maintained throughout the experiment.

Observations on cardiac output and femoral arterial blood pressure were begun after about thirty minutes of oxygen inhalation (about seventy-five minutes after administration of morphine), and 6 successive determinations were made during the next hour. The method was essentially the same as described earlier (2). Electrocardiographic records were made (lead II) immediately after each cardiac output determination, by means of a "Simpli-Scribe" Portable Model Cambridge electrocardiograph.

RESULTS

Sixty determinations were made on 10 dogs. The range of cardiac index was 1.33-6.73, with a mean of 3.24 ± 0.16 l./min./m.² The standard deviation was 1.25. The range of systolic blood pressure was 145-217, with a mean of 182 mm. of Hg. The range of diastolic blood pressure was 54-128, with a mean of 87 mm. of Hg. The range of mean blood pressure was 84-154, with a mean of 119 ± 1.31 mm. of Hg. The standard deviation was 10.05.

The range of peripheral resistance was 2,575-12,736, with a mean of 5,649 dynes/sec./cm.² By Bazett's formula the range of peripheral resistance was 55-246, with a mean of 124 ± 5.52 . The standard deviation was 42.78. The range of heart rate was 68-229, with a mean of

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114 beats per minute. The range of stroke index was 8-51, with a mean of 30 cc./beat/m.²

No cardiac irregularities were noted. A deep S and inverted T waves were noted frequently.

In order to test the variability of cardiovascular functions a series of 6 successive determinations was made on each dog, at approximately 10-minute intervals. The means found for the 10 dogs on successive determinations are presented in table 1.

The following differences were found between the means of the first and of the sixth series of determinations. The cardiac index increased 21 per cent, the systolic blood pressure rose 3.4 per cent, the diastolic blood pressure rose 8.2 per cent and the mean blood pressure rose 5.1 per cent. The peripheral resistance (absolute units) decreased 15.8

TABLE 1
RESULTS OF A SERIES OF SIX SUCCESSIVE DETERMINATIONS OF CARDIAC OUTPUT

Dye Curve Number	Number of Dogs	Cardiac Index (l./min./m. ²)	Blood Pressure (mm. of Hg)			Peripheral Resistance		Heart Rate (beats/min.)	Stroke Index (cc./m. ²)	Duration of Thiopental Anesthesia (min.)
			Systolic	Diastolic	Mean	Absolute Units (dynes/cm. ²)	Hazett Formula			
1	10	3.00	178	85	116	6,229	135	115	26	44
2	10	2.93	182	87	118	6,180	135	109	27	54
3	10	3.27	185	87	119	5,532	120	115	29	63
4	10	3.29	181	86	117	5,349	117	109	31	74
5	10	3.22	181	88	119	5,363	119	119	31	84
6	10	3.63	184	92	122	5,243	116	105	33	93

per cent, the heart rate decreased 9 per cent, and the stroke index increased 27 per cent.

DISCUSSION

When the results of these 60 observations under morphine sulfate and thiopental sodium are compared with the 57 under thiopental alone (2) some interesting facts are noted. The most striking difference is the smaller range in the present series. This is evident in all the cardiovascular functions except stroke index.

A second striking difference is the lower mean values in the present series in all cardiovascular functions except peripheral resistance and stroke index. When morphine sulfate is given before thiopental, the cardiac index is 13.8 per cent lower, the systolic blood pressure is 4.2 per cent lower, the diastolic blood pressure is 26.9 per cent lower, the mean blood pressure is 16.8 per cent lower, the total peripheral resistance is 8.5 per cent higher, the heart rate is 41.2 per cent lower and the stroke index is 57.9 per cent higher than when thiopental alone is used.

The trend of cardiovascular functions between 44 and 93 minutes after the administration of thiopental (two to three hours after the administration of morphine) differs from the trend after thiopental alone. When morphine and thiopental are administered the increase in cardiac index is less marked and the decrease in peripheral resistance is less marked, while the decrease in heart rate and increase in stroke volume are more marked. The systolic, diastolic and mean blood pressures rose during the experimental period, whereas they all fell when thiopental alone was administered.

It was not possible for us to determine the cardiac output in unanesthetized dogs, with the facilities at hand. The results which have been found by other investigators in unanesthetized dogs cover a wide range (3-8). The effect of morphine on cardiac output has been a moot point. Marshall (9) stated that morphine sulfate had no effect on cardiac output. Tappan and Torrey (10) stated that the cardiac output decreased 15-35 per cent during the hour after morphine injection. Blalock (11) found a mean cardiac output of 2.30 l./min. on 6 trained, unanesthetized dogs and 1.29 l./min. on 13 dogs after morphine ($\frac{1}{2}$ to $1\frac{1}{4}$ grains). In a later report, Blalock (12) stated that the cardiac output of morphinized dogs may be constant for a period of hours after an initial decrease within the first 2 hours after morphine. He used 4-6 mg./kg. in this series. Moore and others (13) found a range of 3.19 to 4.22 l./min. by the Fick method, in 3 dogs, after the administration of 10 mg. of morphine per kg. Remington and others (14) found a mean cardiac index of 2.63 l./min./m.² in dogs, after the administration of 10 mg./kg. of morphine sulfate. We have made no observations with morphine alone, but the values found with the combination of morphine and thiopental are somewhat higher than those for morphine reported by others. The reports in the literature deal with dogs on room air whereas our dogs were inspiring oxygen.

Deyrup and Root (6) found a range of 1,900-8,300 dynes/sec./cm.² for peripheral resistance in 7 unanesthetized dogs. This range is greater than that reported by Bing and others (5). No reports of peripheral resistance under morphine alone have been found. The range of peripheral resistance found in our dogs under morphine and thiopental was less than that found by several investigators using a variety of anesthetics (15-18).

SUMMARY

Several cardiovascular functions have been observed in dogs under morphine sulfate-thiopental sodium-oxygen anesthesia. The results have been compared with those observed in dogs under thiopental sodium-oxygen, without any preanesthetic agent. With the exception of stroke index, the range found in the morphine-thiopental series was less extensive than that found with thiopental alone. With the ex-

ception of total peripheral resistance and stroke index, the means of the various cardiovascular functions were lower when morphine was used as a preanesthetic agent. When morphine was administered before thiopental the diastolic blood pressure was markedly lower, the heart rate much slower and consequently the stroke index was much larger than with thiopental alone.

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