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Studies In Abdominal Distention

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STUDIES IN ABDOMINAL DISTENTION

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By

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V. B. J.

D E D I C A T E D

to

My Mother

Mrs. Mollie Powell

B I O G R A P H Y

The author, Valerie B. Johnson, was born in Houston, Texas, in 1920. She attended Crawford Elementary School in that City from 1926 to 1932. She attended Phillis Wheatley High School from 1932 to 1936 and in 1936 was graduated from that school. From 1936 to 1940 she attended Prairie View State College, Prairie View, Texas and received a B. S. degree. In 1943 she enrolled in the Graduate School at Prairie View State College, Prairie View, Texas.

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INTRODUCTION

Experiments have increased in number within recent years on the problem of Abdominal Distention. Gatch [5] has stated that "distention is the primary cause of death from all forms of bowel obstruction, mechanical or paralytic, and most of the other supposed and suggested causes of death cannot exist in the absence of distention." Gilbert, Leroy and Feun [6] have performed a number of experiments showing the effect of abdominal distention on coronary blood flow. In these experiments they have shown that distention of the stomach with air causes a decrease in coronary flow, mediated by a reflex over the vagus nerve causing vasoconstriction of the coronary vessels, as is typical of Angina Pectoris. van Duyn [4] has shown that abdominal distention is concluded to be at least one important cause of a degenerative leucocyte picture.

The importance of this problem reflects itself in the great questions concerning gaseous distention of the stomach and intestine, present in obstruction of the bowel and in some cases of Peritonitis associated with Acute Appendicitis. Also involved is this problem, although more chronically, is the distention of the abdomen during the presence of tumors and during pregnancy.

From observation of routine experiments, "A Variety of Maneuvers" and "Reflexes of Clinical Interest and Importance," Luckhardt [7] found that a balloon inflated in the abdominal cavity (thoracic cavity as well) would cause a sudden fall in blood pressure. It, therefore, appeared interesting to the author to determine how long the blood pressure would remain low if a balloon was continuously inflated and if similar curves of blood pressure could be obtained as shown by Booker.[2] Hence, the importance of this work also in studying the problem of shock.

METHODS OF PROCEDURE

Approximately twelve dogs were used for these experiments. The animals were anestheticized with nembutal and the carotid artery was connected by a cannula to a mercury manometer for recording blood pressure. Respiration was recorded by the usual pneumograph-tambour set-up. An incision was made along the mid-line of the upper portion of the abdomen, just beneath the level of the diaphram. A balloon was inserted into the peritoneal cavity and closed by suture. After a normal record was taken, the balloon was inflated. In a few experiments, air rather than a balloon was used to inflate the abdomen or the stomach. In one case a calloon was placed in the stomach and a balloon was placed in the peritoneal cavity; and alternate and concurrent inflation was performed. In all experiments blood was drawn (1 to 2cc) every half hour in order to make blood counts and hematocrit values were arrived at by use of hematocrit tubes. Two animals were used as control experiments; in these experiments the animals remained anestheticized (with blood pressure and respiration set-up) and with a balloon in the abdomen uninflated, without significant change in blood pressure.

INTERPRETATIONS AND RESULTS

Observation of Figure I will reveal a typical picture showing circulatory failure following inflation of a balloon in the abdomen over a period of two hours. It will be noted that the arterial blood pressure presents (1) a sudden fall, (2) an attempt to compensate for this fall, (3) and a period of gradual decline and circulatory failure. The first period is the result of obstruction of the abdominal veins, reducing venous return to the heart and therefore causing a reduced cardiac output. Booker in 1941 and 1943, aforementioned, in his Traction on the Liver experiments, got the same three phases as noted in these experiments. An attempt to compensate is probably the result of reflex vaso constriction of the abdominal vessels or the contraction of the spleen in an attempt to maintain a normal blood pressure level. The third picture of gradual decline and circulatory failure is the result of venous stasis, a probable damage to the vasomotor center, and hemoconcentration caused by a loss of fluids into the abdominal cavity, which results from increased venous pressure. All Animals showed quantities of hemorhagic fluid in the abdominal cavity. That hemoconcentration occurs can be seen by an observation of Table One. Changes in blood concentration have been described by Gatch, mentioned above and Battersby [1], who have observed that intraperitoneal loss of blood protein and chloride results from distention.

It is important to stress that although immediately the fall in blood pressure results from congestion in the abdominal area, the gradual decline of the blood pressure is caused by a failure of blood to return toward the heart from parts below the abdomen, because of the marked amount of pressure against which venous blood (ordinarily at low pressure) must flow. In the highly muscular regions of the body, venous return to the heart is facilitated by muscular massage, "buffered" by the presence of valves. There are, of course, no valves in the abdominal veins and no marked muscular massage; the intestines themselves "act similar to fluid mass in favoring venous return." Overholt [8]. Added to this is the increased negative pressure of the thoracic cavity at inspiration and the increased contraction of the abdominal muscles (raising the abdominal pressure slightly) at that same phase of respiration. When, however, the abdomen is distended, the pressure is raised too high for adequate contraction of the abdominal muscles. Hence, inspiration is in part impaired. This in turn, impairs the "sucking" of the blood into the heart by increased negative pressure. Cardiac output is therefore reduced and blood pressure falls.

This work would seem to show, then, that stimulation of the vaso-constrictor fibers of the heart, decreasing coronary flow, when the stomach is distended, may well be a factor in circulatory failure, since cardiac damage from myocardial anemia, will affect the efficiency of the heart. On the contrary, this factor is not as important as the factors mentioned above in causing circulatory failure since section of the vagi in the experiments reported by this author resulted in a fall in blood pressure, if the sectioning was done an hour or more after distention had been made. This adds to the point of view that the vagi carry vaso-constrictor fibers which are themselves not active (and then as protection) until the body is under physiological stress and strain.

It appears unimportant as to whether or not the stomach is inflated with air; the abdominal cavity with air, or a balloon is inflated inside the abdominal cavity (Figure IV). In each instance the blood pressure falls and the factors involved are the same in each case.

According to Crowley [3], synchronous fluctuations in the blood pressure are apparently initiated by afferent impulses arising from the stimulus of distention and mediated by fibers of the splanchnic nerve radicals to the destended segments and subsequently by pathways in the spinal cord, since they are eliminated by complete section of the cord or nerves. This does not seem an adequate explanation of circulatory failure, since in the experiments reported in this paper, blood pressure fell gradually (after an initial rise) upon distention of the abdomen following section of the spinal cord. (Figure V.) The rise in blood pressure obtained at first is due likely to increased peripheral resistance at the abdominal aorta. In some few instances a similar rise occurs when the cord is intact.

It might be interesting to note in these experiments that there is no temporary inhibition of respiration as observed by Luckhardt, Alpert and Smith (7) and by Booker, mentioned above, when they exerted traction on the liver. They described a reflex, mediated partially over the vagi and partially over sympathetic fibers from the spinal cord, which inhibited the respiratory center. Such reflex is apparently not involved in these experiments.

SUMMARY AND CONCLUSIONS

1. Studies have been made on the distention of the abdomen (stomach also) with air and with rubber balloons.

2. The results indicate that circulatory failure can be brought about by a constant abdominal distention, particularly where the distention approaches or exceeds the normal venous pressure in the abdomen (20 mm Hg).

3. Venous pressure rises and there is an extravasation of fluid drom blood, with a consequent reduction in blood volume.

4. It is likely that there is also a cardiac effect created early in the distention resulting in decreased blood supply to the heart (vasoconstriction of the coronaries) which affects the efficiency of the heart.

TABLE I
SHOWING HEMOCONCENTRATION OF
BLOOD AS INFLATION IS
MAINTAINED

PERIOD	BLOOD PRESSURE	HEMATOCRIT		CELL COUNT
		CELLS	PLASMA	
1 No inflation	110 mm Hg.	35	65	6,000,000
2 After ½ hour inflation	85 mm Hg.	48	52	10,000,000
3 After 1 hour inflation	50 mm Hg.	45	55	8,320,000
4 After 1½ hour inflation	45 mm Hg.	48	52	7,600,000

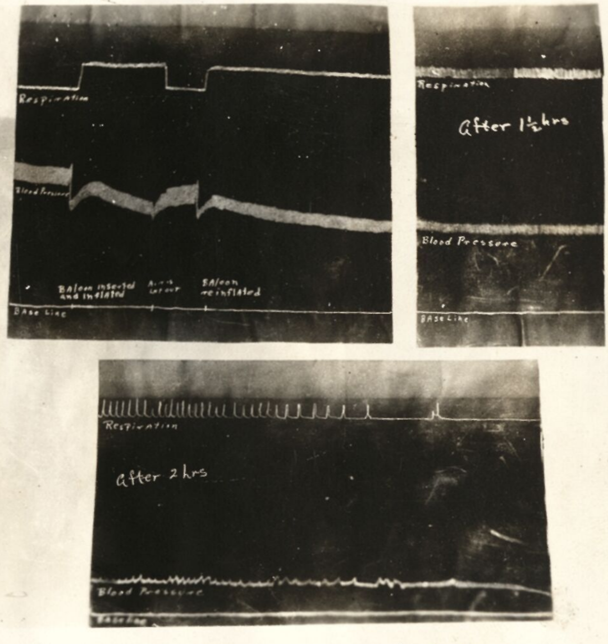

Figure 1 - Showing circulatory failure from continuous inflation of a balloon in the abdominal (Peritoneal) cavity.

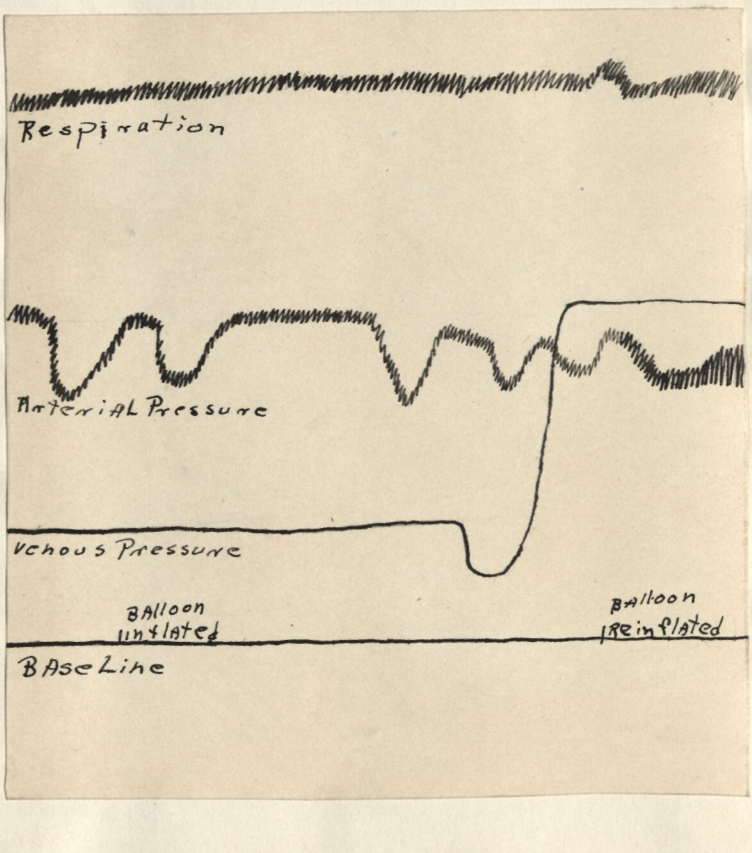

Figure 12 - Showing increased venous pressure following inflation of a balloon in the abdominal cavity.
(Reproduced drawings from actual tracings.)

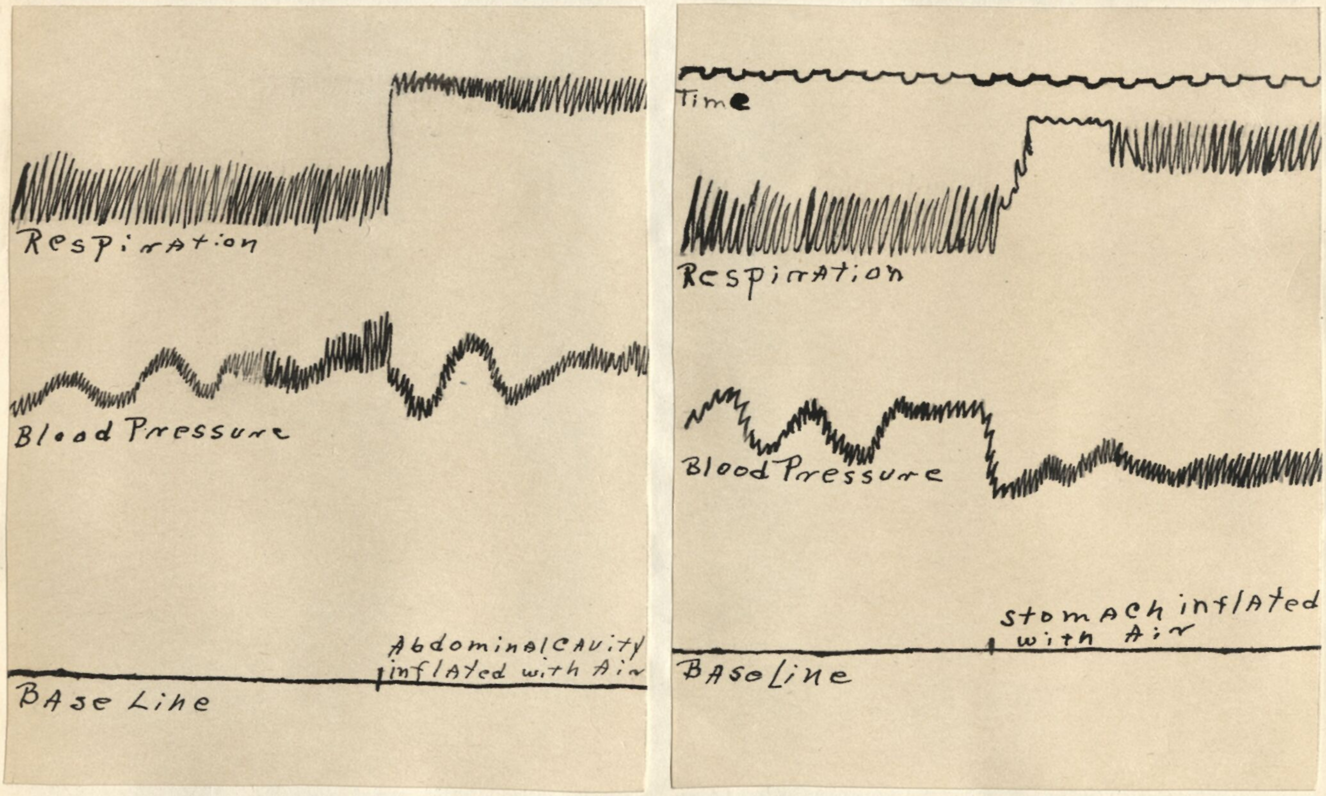

Figure 3 - An experiment designed to show that blood pressure falls whether the inflation is in the peritoneal cavity itself or in the stomach.
(Reproduced drawings from actual tracings.)

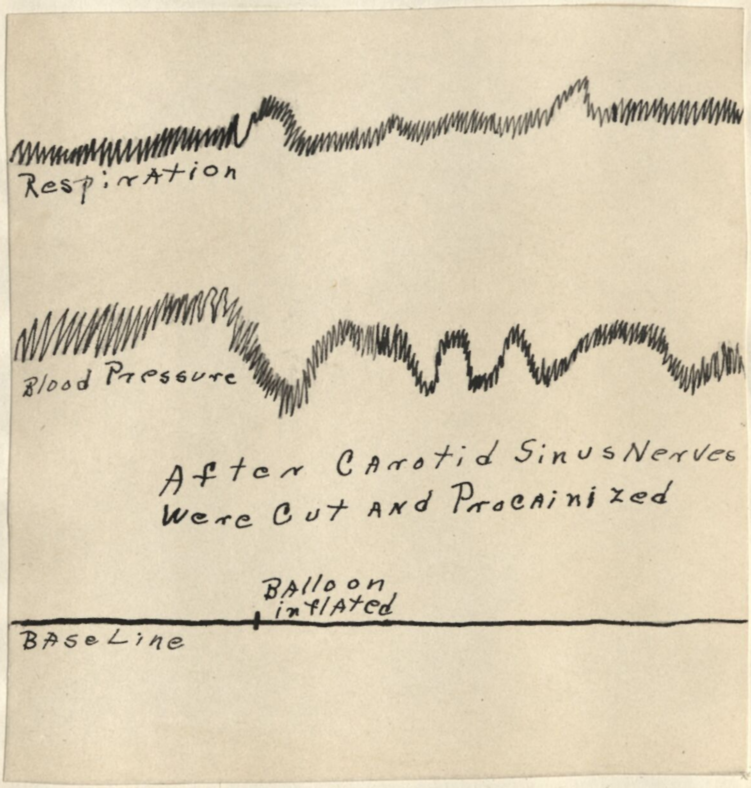

Figure 4 - An experiment designed to show that the cavotid sinus mechanism is not involved in the blood pressure responses following distention of the abdomen.

(Reproduced drawings from actual tracings.)

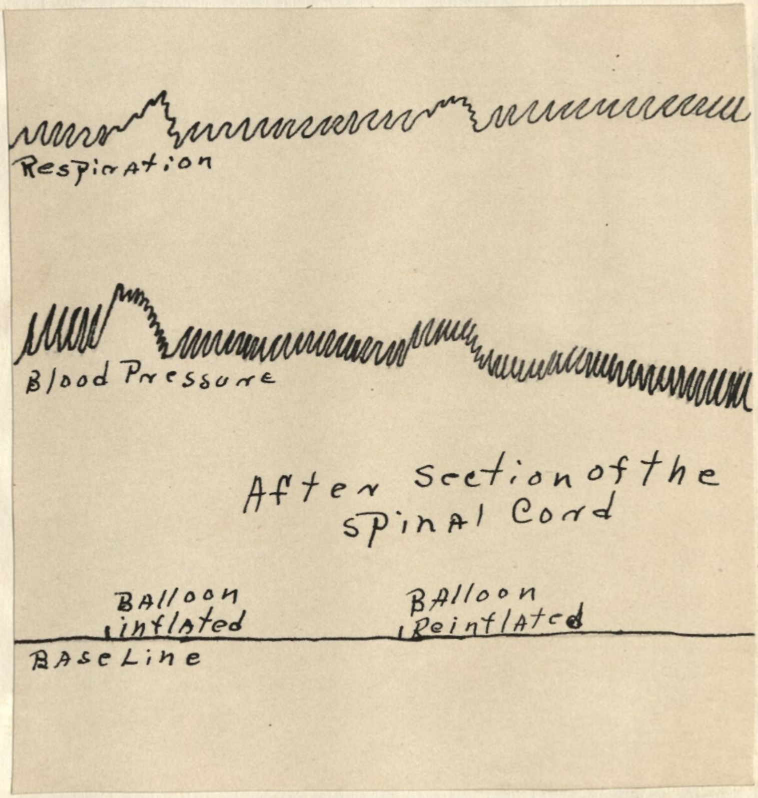

Figure 5 - Showing blood pressure responses following inflation of a balloon, the cord having been transsected. Although the fall in blood pressure is not acute, a gradual decline can be seen.

(Reproduced drawings from actual tracings.)

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