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THE ACTION OF THE SPLANCHNIC NERVES ON THE SPLEEN.

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Schiff [1867] was the first to show that stimulation of the splanchnic nerves causes contractions of the spleen. Roy [1881] showed that stimulation of either the right or left splanchnic nerve produces a powerful and rapid diminution in the volume of the spleen. Schäfer and Moore [1896] confirmed the results of Roy, *i.e.* that stimulation of the splanchnic nerve is followed by rhythmical contractions of the spleen. The splanchnic nerves, however, supply fibres to the suprarenal glands. Adrenaline produces splenic contraction followed by rhythmical contractions. Working as they did before the discovery of the suprarenal function by Schäfer and Oliver [1895], the earlier workers did not take into consideration the suprarenals, and also they did not distinguish between n. splanchnicus major and minor. In our experiments we have tried to show the effect on stimulation of the removal of the suprarenals, and to determine whether both n. splanchnicus major and minor supply fibres to the spleen.

All our experiments have been done on cats. In the cat n. splanchnicus major comes off the sympathetic cord at the level of the XIIIth thoracic vertebra and the minor at the level of Ist (i) and IInd (ii) lumbar vertebræ.

Method.

The animal was anæsthetized with urethane and ether. An incision was made in the middle line. The inferior mesenteric artery was ligated first, and then the superior mesenterics. After allowing time for all the blood from the intestine to return to the circulation, the veins were ligated and the intestines removed. The spleen was freed from the omentum and stomach by applying ligatures in suitable places, after which it was put in a plethysmograph similar to that used by Schäfer.

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Exp. 1. Cat No. 18. *B.W.* 2·7 kg. The right n. splanchnicus major was stimulated for 10 sec. The general blood-pressure started to rise at once, increasing from 78 mm. Hg to 105 mm. Hg. The spleen volume started to decrease at once and fell by 2 c.c. The decrease in splenic volume was followed by rhythmic contractions of the spleen which lasted for several minutes. The left n. splanchnicus major was then stimulated for the same time and with the same current. There was a rise of general blood-pressure from 90 mm. Hg to 110 mm. Hg. The spleen volume decreased by 2 c.c. and this decrease was followed by rhythmic contractions of the spleen which were of the same amplitude as in the first case, and also lasted for several minutes.

The results in all our experiments have been practically the same, *i.e.* the stimulation of the right or of the left n. splanchnicus major produced a contraction of the spleen followed by rhythmical contractions. Roy stated that the splanchnics of both sides supplied the spleen, but he made no distinction between n. splanchnicus major and minor.

Exp. 2. Cat No. 52. *B.W.* 2·7 kg. The left suprarenal body was removed after ligaturing the incoming and outgoing vessels. Before removal of the suprarenal body the left n. splanchnicus major was stimulated for 10 sec. The blood-pressure rose from 80 mm. Hg to 90 mm. Hg. The spleen contracted and the volume decreased by 0·85 c.c. The contraction of the spleen was followed by distinct rhythmic movements, and the spleen returned to its previous volume in 2 min. After removal of the suprarenal body the general blood-pressure was again 80 mm. Hg, and after stimulation of n. splanchnicus major for 15 sec. it rose to 90 mm. Hg. The spleen volume decreased by 0·77 c.c. The contraction of the spleen was followed by less distinct rhythmic movements and the spleen returned to its original volume in 50 sec.

It will be noticed that after the removal of the suprarenal body the initial contraction of the spleen evoked by stimulation of the peripheral end of the left n. splanchnicus major was less in degree and in duration than when the suprarenal was *in situ*; also that the rhythmic contractions which followed were of less amplitude. We can suppose that stimulation of n. splanchnicus major produces its effect on the spleen (1) directly, (2) through the stimulation of the suprarenals. That the difference between stimulation of the left n. splanchnicus before and after the suprarenals are removed is not due solely to operative interference may be gathered from Exp. 3 (below).

Schäfer and Moore state that if the spleen is denervated and the splanchnic stimulated there is a passive dilatation of the spleen due to a rise in blood-pressure, but our results are different, as illustrated by the following experiment.

Exp. 3. Cat No. 59. *B.W.* 2·5 kg. The spleen was denervated and the left n. splanchnicus major stimulated for 25 sec. General blood-pressure rose from 89 mm. Hg to 93 mm. Hg in 7 sec., and then fell to 77 mm. Hg, and came back to normal in 35 sec.; 5 sec. after starting stimulation the spleen started to contract strongly, and decreased in splenic volume by 1 c.c. The contraction of the spleen was followed by distinct rhythmic movements which

lasted for several minutes, and the spleen returned to its original volume in 70 sec. (Fig. 1*a*). The left suprarenal body was then removed. After removal the general blood-pressure was 83 mm. Hg. Stimulation of left n. splanchnicus major produced practically no change in general blood-pressure and in splenic volume (Fig. 1*b*); but stimulation of the splenic nerves always produced a contraction of the spleen, a rise of general blood-pressure, and slight rhythmical movements of the spleen.

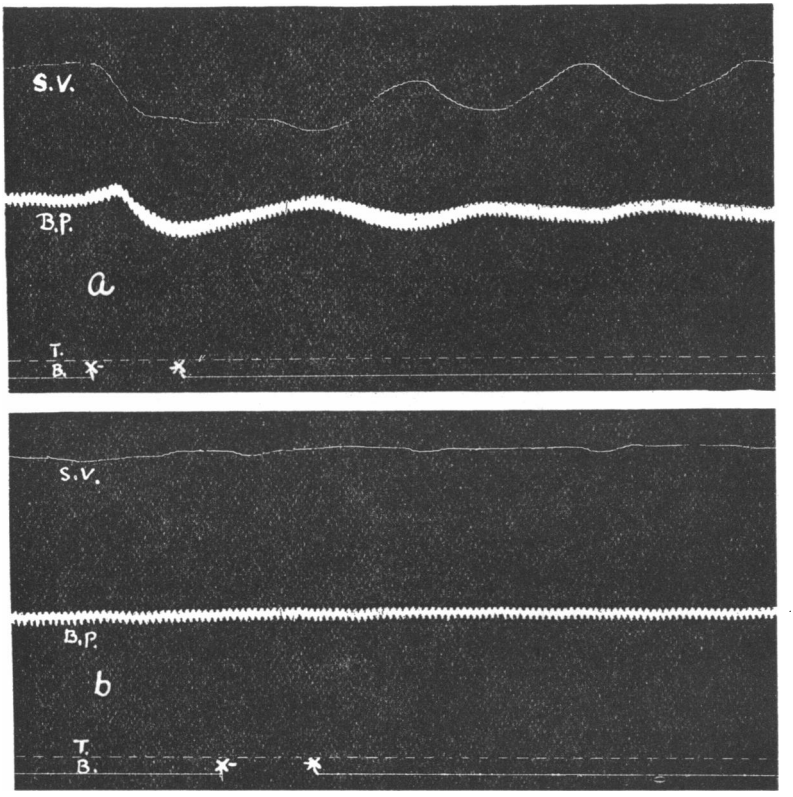

Fig. 1. *S.V.* splenic volume. *B.P.* general blood-pressure (carotid art.). *T.* time, 5 sec. *B.* base line at 0 mm. Hg. *x–x*, stimulation of n. splanchnicus major.

The stimulation of the n. splanchnicus major, after denervating the spleen, produced a contraction of the spleen, a slight rise of blood-pressure followed by a fall which is a typical adrenaline action. The contraction of the spleen was followed by a rhythmical action. This was due to the effect of adrenaline, because after removal of the suprarenal bodies, stimulation of the n. splanchnicus major no longer produced contraction, but stimulation of the peripheral end of the cut splenic did so.

Exp. 4 describes the results usually obtained from stimulation of the left n. splanchnicus minor (i).

Cat No. 140. *B.W.* 3·5 kg. Left n. splanchnicus minor (i) was stimulated for 30 sec. During stimulation the blood-pressure rose to 172 mm. Hg, fell again to 150 mm. Hg, and

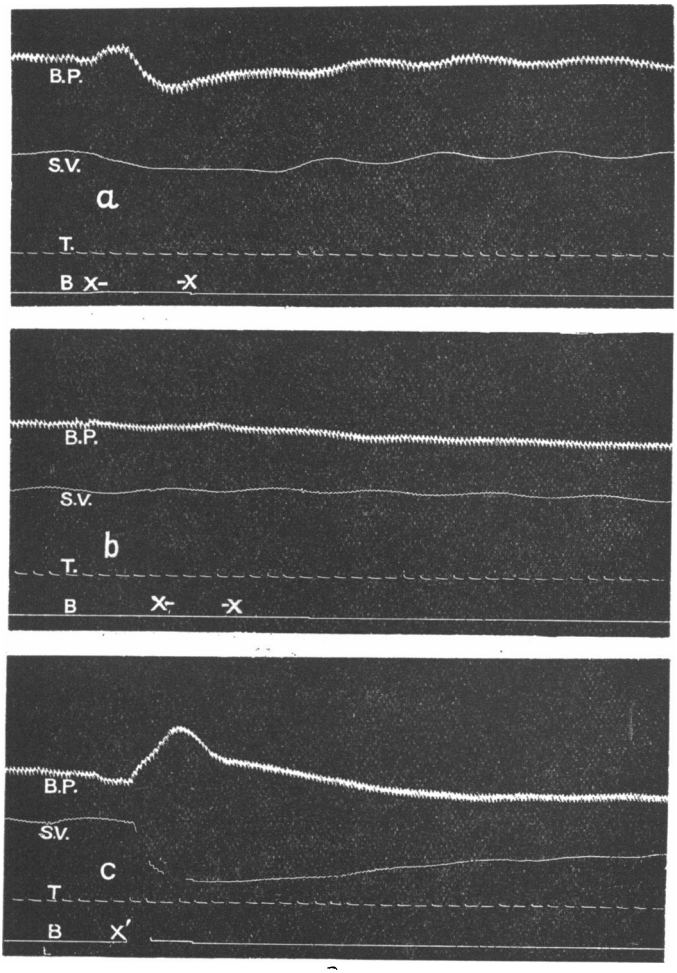

Fig. 2. *B.P.* general blood-pressure (carotid art.). *S.V.* splenic volume. *T.* time, 5 sec. *B.* base line at 40 mm. Hg. *x–x*, stimulation of n. splanchnicus minor (i). *x'*, beginning of stimulation of n. splanchnicus major.

returned to normal 50 sec. after stimulation. Undulatory changes in blood-pressure followed. The splenic volume fell by 0·55 c.c. during stimulation; 25 sec. after stimulation, rhythmic contractions of the spleen started, which synchronized with undulatory changes

in blood-pressure (Fig. 2*a*). The left suprarenal body was then removed. General blood-pressure was 144 mm. Hg. The left n. splanchnicus minor (i) was stimulated for 30 sec. There was practically no change in the blood-pressure and splenic volume, such as had appeared when the suprarenal was intact (Fig. 2*b*). The left n. splanchnicus major was then stimulated for 15 sec. There was a rise of blood-pressure from 112 mm. Hg to 136 mm. Hg, but the rise was not followed by a fall below normal which is produced when the suprarenal is intact. The spleen volume decreased by 1·8 c.c. (Fig. 2*c*).

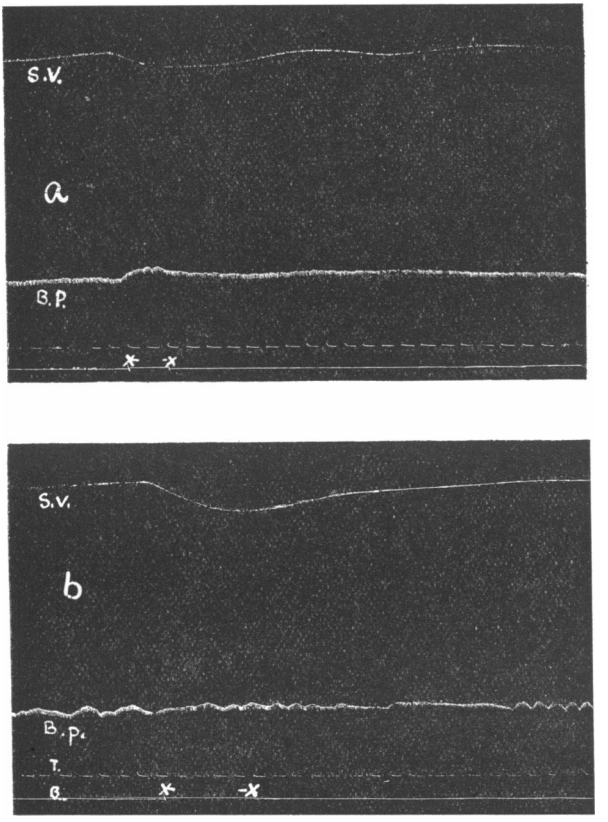

Fig. 3. *S.V.* splenic volume. *B.P.* general blood-pressure (carotid art.). *T.* time, 5 sec. *B.* base line at 15 mm. Hg. *x–x*, stimulation of n. splanchnicus minor (i).

Exp. 5 illustrates the results obtained in a minority of cases.

Cat No. 142. *B.W.* 3 kg. The left n. splanchnicus minor (i) was stimulated for 10 sec. After stimulation, the general blood-pressure rose from 55 mm. Hg to 60 mm. Hg; the spleen volume decreased by 0·4 c.c.; and the spleen started rhythmic contractions (Fig. 3*a*). The left suprarenal body was then removed. General blood-pressure was 55 mm. Hg. The left n. splanchnicus minor (i) was then stimulated for 25 sec. There was a very slight change in the blood-pressure and the spleen contracted by 0·6 c.c. (Fig. 3*b*).

Our experiments show that stimulation of the n. splanchnicus minor (i) after removal of suprarenal bodies sometimes produces a contraction of spleen, while at other times there is no effect on the spleen. This may be due to the n. splanchnicus minor (i) sometimes supplying fibres both to the spleen and suprarenal bodies and at other times only to the suprarenal bodies. The stimulation of the right n. splanchnicus minor (i) produces similar results.

In the case of the n. splanchnicus minor (ii), we could obtain no reliable evidence that this nerve contains fibres for the spleen or suprarenal bodies.

SUMMARY.

1. Nerve fibres to the spleen and suprarenal bodies are carried chiefly through the n. splanchnicus major. Stimulation of the n. splanchnicus major produces a direct action on the spleen, and also an indirect action through the secretion of adrenaline, both of which produce a contraction of the spleen followed by rhythmic contraction.

2. Nerve fibres to the spleen and suprarenal bodies are also carried in the n. splanchnicus minor (i). Stimulation of these nerves produces sometimes both direct and indirect effects on the spleen, and at other times only an indirect effect.

3. We failed to find nerve fibres from the n. splanchnicus minor (ii) to either the spleen or suprarenal bodies.

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