generous cooperation in supplying most of the parathormone used in these experiments.

4929

The Nerve Pathways in the Vomiting of Peritonitis.

FRANKLIN E. WALTON, ROBERT M. MOORE AND EVARTS A. GRAHAM.

From the Department of Surgery, Washington University School of Medicine, and Barnes Hospital, St. Louis, Missouri.

A careful review of the literature has failed to disclose any explanation of the mechanism of vomiting in peritonitis which is supported by experimental facts. No recorded attempt by critical experiment to determine the nature of the emetic stimulus and to discover its manner of action could be found although the phrase "peritoneal irritation" was noted in practically every work upon peritonitis and vomiting. This present study was undertaken because of the apparent lack of proof that vomiting in peritonitis is really due to irritation of the peritoneum.

Although the emetic stimulus has usually been considered to be a nervous impulse, it was thought possible that it might either be a hormone or a toxin carried in the blood. Since emesis is induced by the direct application to the vomiting center of minute amounts of certain normal constituents of the blood, such as cholin and histamine, it is possible that when one of these is present in the blood in an increased amount, it may cause nausea and vomiting. In intestinal obstruction, which frequently complicates peritonitis, histamine may be present in the blood in abnormally large amounts, and, in such cases, may quite possibly constitute the stimulus to vomiting.

It is believed that observations recently made in this laboratory tend to exclude the probability of either a toxin or a hormone providing the important emetic stimulus in peritonitis. For example, in a series of 15 normal cats intraperitoneal injection of 10 cc. of a 50% turpentine emulsion produced vomiting within 6 seconds after the injection, a reaction time which seemingly would preclude a chemical stimulation of the center and yet be entirely within the limits of a reflex phenomenon. Furthermore, as will be described shortly, peritonitis failed to produce vomiting in 6 cats in which the vagus nerves had been divided in the thorax and the abdominal sympathetic and splanchnic innervation destroyed.

If the emetic stimulus is a nervous impulse, the 3 possible pathways to be considered are the vagi, the sympathetics and those cerebrospinal nerves which also supply the peritoneum, namely the phrenics, lower 6 thoracics, the ilio-hypogastrics and the ilio-inguinal nerves.

The method of study has been as follows: A 24-hour bouillon culture of *B. coli* was injected intraperitoneally into each of 12 normal cats and 7 normal dogs and was found in every instance to produce a fatal peritonitis, the duration of life varying from 5 to 12 days. Without exception, vomiting was a constant feature of the disease. These animals served as controls.

Twelve other cats, which had received similar injections and which also had been subjected to bilateral low intrathoracic vagotomy performed 60-72 hours after injection, failed to differ in any respect from animals whose vagi were intact.

Bilateral abdominal sympathectomy and splanchnotomy was performed in 5 cats. In these animals, a similarly induced *B. coli* peritonitis produced vomiting which did not differ either in character or frequency from that seen in the controls.

In 5 dogs suffering from a colon bacillus peritonitis, the spinal cord was transected at the level of the second thoracic vertebra. Vomiting was feeble in character, thereafter, inasmuch as the innervation of the abdominal muscles was destroyed, but was quite definitely present and persistent.

Six cats were first subjected to a bilateral low intrathoracic vagotomy and allowed to recover. Two weeks later, the abdominal sympathetic chains were resected and the splanchnic nerves divided. After one week of convalescence, an intramuscular injection of lobelein sulphate (0.003 mgm. per kilo) was given and prompt emesis resulted in each instance, demonstrating the integrity of the efferent emetic mechanism. These animals were next given a *B. coli* peritonitis. In this series a striking result was obtained. Every animal died within 6 days' time and postmortem examination revealed in each instance a frank purulent general peritonitis, the diagnosis being confirmed by microscopic section. Yet not one of the 6 animals vomited even once during the course of the disease.

Obviously these animals were able to vomit as demonstrated by lobelein sulphate. The emetic stimulus was present as evidenced by all of the animals previously observed. In these animals then, the emetic action of the peritoneal inflammation had been effectively abolished by the operative procedure, namely by vagotomy and sympathectomy.

In resumè, in each of 46 animals in which either the vagus mechanism or the abdominal sympathetic mechanism or both were intact, vomiting was a prominent accompaniment of peritonitis. In each of 6 animals in which both vagal and sympathetic paths were destroyed, no instance of vomiting was recorded although the peritonitis was uniformly fatal. It would seem then that colon bacillus peritonitis produces vomiting through a local irritation of afferent nerve endings and not through toxic or humoral changes. The afferent emetic impulse from the peritoneum to the medullary centers evidently traverses only vagal or sympathetic paths since in the absence of these paths, although cerebrospinal nerves (including the phrenics) are still active, emesis fails to occur. Since the destruction of only one of these paths, *i. e.*, vagal or sympathetic, fails to abolish the vomiting of peritonitis, it would appear that the afferent emetic impulse traverses either path with equal facility. This observation is in line with that of Hatcher and Weiss,[1] who found that afferent emetic impulses produced by large oral doses of mercuric chloride ascend over either the vagi or sympathetics depending on the integrity of the tract.

Summary. The experiments here reported show that the vomiting of peritonitis is the result of the stimulation of afferent nerve endings located in the peritoneum. The emetic impulse thus initiated passes to the medullary center by way of sensory nerve fibers which are included in both the vagal and sympathetic trunks. Section of these trunks prevents the occurrence of vomiting in peritonitis although phrenic and other cerebrospinal nerve paths are left undisturbed. Since, by sympathectomy alone or by vagotomy alone, vomiting in peritonitis is not abolished, the afferent emetic impulse evidently traverses either path with equal facility.

[1] Hatcher, R. A., and Weiss, Soma, *J. Pharm. and Exp. Therap.*, 1924, xxii, 139.