

Conflicting views are held regarding the mechanisms of the formation and secretion of bile. On the one hand, I. P. Pavlov [10] and L. A. Orbeli [9] consider that conditioned-reflex factors play practically no part in the mechanism of bile secretion, while on the other hand, K. M. Bykov and his co-workers [3-6, 8, 11, 12, 16] claim that natural conditioned stimuli are powerful factors activating the work of the pancreas and liver.

The object of the present investigation was to study the effect of various natural conditioned stimuli on the secretion of gastric juice and on bile formation.

#### EXPERIMENTAL METHOD AND RESULTS

Observations were made on three male dogs. As a first stage a gastric fistula was formed in the animals, and a polyvinyl chloride tube\* inserted, while the common bile duct was exteriorized by I. P. Pavlov's method (the dogs Belyi, Pushok, Ryzhii). Subsequently an esophagotomy was performed on the dog Belyi and a fistula formed into the gall bladder.

Experiments were carried out 16-18 h after the animals had been fed. Each experiment began with washing out the stomach with warm water (37°) after which the animals were kept secured to the frame for 1 h, during which time observations were made on them. In a resting state of the gastric glands and in the absence of excretion of bile from the fistula into the common bile duct, the experiment was performed in one of the following modifications; a) feeding with gastric fistula closed; b) stimulation by the sight of food for 5 min; c) sham feeding for 5 min; d) feeding with gastric fistula open; and e) the animals while strapped to the frame received bone meal.

The food stimuli used in the experiments were meat (100 g), milk (600 ml), egg yolk (50 g), meat broth (200 ml), and bone. Meat, milk, and, in particular, egg yolk are known to have a marked stimulant action on bile formation and to produce the secretion of bile into the duodenum.

In the experiment in which food stimuli were given to the animals with the gastric fistula closed, results were obtained in full agreement with those described previously [1, 2, 7, 13-15] and frequently confirmed by many investigators. The analysis of these results will not be described.

To examine the role of conditioned-reflex factors in the mechanisms of the formation and secretion of bile, experiments were carried out in which the animals were stimulated by the sight of food for 5 min. In this modification of the experiment the dogs showed a marked motor-food reaction (an attempt to reach the food, licking their lips, attempting to seize the food with their paw), demonstrating a high level of excitability of the "food center." However, in not one of the 15 experiments was the secretion of bile increased or bile excreted through the fistula from the duct.

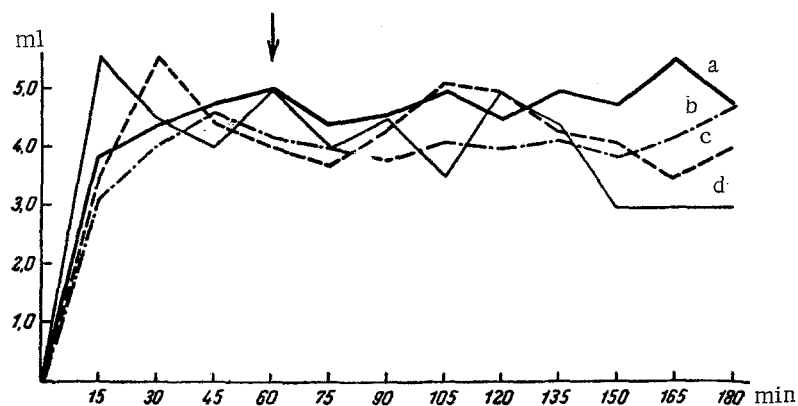
In the experiment with sham feeding with meat and egg yolk, conducted on the dog Belyi, a distinct reaction of the gastric gland was observed (to meat) but stimulation of bile formation and the excretion of bile through the terminal fistula of the duct were never found.

Milk, yolk, and meat broth, given when the gastric fistula was opened, likewise caused no increase in the secretion of bile or its excretion through the terminal fistula of the ducts. Only in some experiments of this series was a transient excretion of bile observed from the fistula of the duct, in a small quantity (1-5 ml). The excretion of bile was not regular in time—it seems that it was due to the periodic contractions of the bile ducts which may also be observed in the absence of digestion.

\*Fistula tubes made of polyvinyl chloride are elastic and, when introduced through a ring of organic glass fixed to the abdominal wall, they allow the stomach to remain in situ, and do not pull it toward the abdominal wall. This causes minimal interferences with the motor function of the stomach.

---

Department of Pathological Physiology, I. P. Pavlov First Leningrad Medical Institute (Presented by Active Member of the Academy of Medical Sciences of the USSR D. A. Biryukov). Translated from *Byulleten' Éksperimental'noi Biologii i Meditsiny*, Vol. 62, No. 10, pp. 21-23, October, 1966. Original article submitted January 7, 1965.



Bile secretion in patient D in a fasting state and after sham feeding. A) May 24; B) May 25; C) May 27; D) June 3, 1963. The arrow indicates the beginning of sham feeding.

Finally, experiments were carried out in which the dogs received a strong stimulus in the form of a meat bone (stewed). In this case, the dog with its paws strapped to the frame, tried helplessly to take the bone into its mouth and to chew it. After 5 min the bone was removed and observations continued on the gastric secretion and the formation and secretion of bile. However, no excretion of bile from the terminal fistula of the duct was observed in any of the five experiments. The reaction of the gastric glands was clear, but was quickly inhibited.

The facts described above were reproduced with surprising accuracy.

Clinical observations made on the patient D, with a drainage tube inserted into the common bile duct by Vishnevskii's method, showed that sham feeding for 10 min with a porridge containing butter (buckwheat, semolina, rice) caused no increase in the excretion of bile from the drainage tube. The rhythm and volume of bile secreted from the drainage tube were unchanged during observations lasting 2 h after sham feeding, and remained at the same level as before "feeding" (see figure \*).

The facts described above show that conditioned-reflex factors (the sight and smell of food) and also the act of eating, temporary stimulation of the receptors of the mouth, esophagus, and stomach, in experiments with the gastric fistula open have no effect on the secretion of bile and do not cause its excretion through a terminal fistula of the bile duct.

In the course of evolutionary and ontogenetic development, reactions ensuring the viability of the organism and contributing to the maintenance of its integrity are formed and consolidated. From this point of view, the development of a reaction of the salivary and gastric glands, appearing in response to the sight, the smell and the taking of food, is fully understandable. Such a reaction is of direct physiological importance and is directed towards the preparation for the taking and digestion of the food. At the same time, it would be physiologically premature to stimulate the secretion of bile and its excretion into the duodenum long before the food has entered the gastrointestinal tract.

The results of the present observations show that the stimulation of bile secretion and the excretion of bile are connected with reflex and humoral influences of the hepato-biliary system of the receptors of the duodenum and stomach, not coinciding in time with the secretory response of the salivary and gastric glands.

#### SUMMARY

Repeated experiments on dogs with a gastric fistula and the common bile duct exposed after I. P. Pavlov, a dog with a stomach fistula, the common bile duct exposed after I. P. Pavlov, a gall bladder fistula and esophagotomy have shown that the appearance and smell of food, sham feeding, and feeding of animals with an open stomach fistula fail to cause an increase in bile secretion and its discharge through the terminal fistula of the common bile duct.

\* Observations were made in the mornings. The bile was collected from the drainage tube ever 15 min for 1 h before breakfast. The patient was then asked to chew the porridge but not to swallow it, and to spit it out into a basin.

The author is grateful to the patient, to S. E. Gurvich, Head of the Surgical Division of the Uritskii Hospital, and to M. B. Ral', assistant in the Department of General Surgery, First Leningrad Medical Institute, for enabling these observations to be carried out.

These findings have been confirmed by the author's observations carried out in a clinic on a female patient with the common bile duct drained after Vishnevskii during her sham feeding.

#### LITERATURE CITED

1. G. Bryuno, Trudy Obshch. Russkikh Vrachei v S.-Peterburge za 1896-1897 (May, 1897), p. 590.
2. G. G. Bryuno, Trudy Obshch. Russkikh Vrachei v S.-Peterburge za 1897-1898 (October, 1897), p. 88.
3. K. M. Bykov, Selected Works [in Russian], Moscow (1953), pp. 110, 161, 184; Vol. 2 (1954), pp. 50, 108, 305.
4. K. M. Bykov and I. T. Kurtsin, Cortico-Visceral Pathology [in Russian], Leningrad (1960), p. 390.
5. S. M. Gorshkova and I. T. Kurtsin, Uspekhi Sovr. Biol., Vol. 16, No. 1 (1943), p. 29.
6. E. P. Ivanov, Russk. Fiziol. Zh., Vol. 13, No. 2 (1930), p. 281.
7. N. N. Klodnitskii, The Excretion of Bile into the Duodenum, Dissertation, St. Petersburg (1902).
8. I. T. Kurtsin, The Mechanoreceptors of the Stomach and the Work of the Digestive Apparatus [in Russian], Moscow-Leningrad (1952), p. 206.
9. L. A. Orbeli, Lectures on the Physiology of the Nervous System [in Russian], Moscow-Leningrad (1938), p. 209.
10. L. P. Pavlov, Lectures on Physiology (1912-1913) [in Russian], Moscow (1952), pp. 115, 135.
11. V. G. Prokopenko, The Cerebral Cortex and the Secretory Activity of the Liver, Dissertation, Leningrad (1939).
12. A. V. Rikkl', Russk. Fiziol. Zh., Vol. 13, No. 2 (1930), p. 268.
13. G. Fol'bort, C. R. Soc. Biol., Vol. 78 (1915), p. 293.
14. G. V. Fol'bort, Russk. Fiziol. Zh., Vol. 1, Nos. 1-2 (1917), p. 63.
15. G. V. Fol'bort, Russk. Fiziol. Zh., Vol. 5, Nos. 1-3 (1922), p. 141.
16. V. M. Shaverin, Arkh. Biol. Nauk SSSR, Vol. 54, No. 5 (1939), p. 53.

---

All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of the first issue of this year.

---