Effects of Gallamine on the Contractile Response of the Stomach in Cats

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Abstract—Stimulation of the vagal trunk in cats anesthetized with pentobarbital sodium produced a contractile response of the stomach during stimulation (initial contraction). Pretreatment with either hexamethonium (0.3 to 30 mg/kg, i.v.) or gallamine (1 to 100 mg/kg, i.v.) dose-dependently produced a delayed contraction, following the initial contraction after stimulation. After the administration of either hexamethonium or gallamine produced a maximum delayed contraction, then an additional dose of gallamine or hexamethonium was administered. The subsequent treatment further augmented the delayed contraction. The results indicate that gallamine induced the delayed contraction by a mechanism different from hexamethonium.

It was reported (1, 2) that electrical stimulation of the vagal trunk in cats anesthetized with pentobarbital-gallamine produced a biphasic contractile response of the stomach: an initial contraction after stimulation. The initial contraction is sensitive to hexamethonium, but the delayed contraction is resistant to hexamethonium. In contrast, stimulation of the vagal trunk produced only an initial contraction during stimulation in cats anesthetized with pentobarbital alone. The administration of gallamine, however, induced a delayed contraction, following the initial contraction after stimulation. The present study was undertaken to investigate the effects of gallamine on the delayed contractile response of the stomach to stimulation of the vagal trunk under pentobarbital anesthesia. Effects of gallamine on the initial contraction will be discussed in another paper.

Experimental procedure was the same as described by Okamoto et al. (1, 2). Twenty cats of either sex, weighing 2.5 to 5.0 kg, were used. The animals were deprived of food but allowed free access to water 12 hr prior to the experiments. Animals were anesthetized with pentobarbital sodium (60 mg/kg, i.p.), and an additional sodium was administered when necessary. A tracheal cannula was inserted. Artificial respiration was maintained by a respiration pump. The respiration rate was 15/min with an air volume of 70 ml per stroke. The left femoral vein was catheterized for drug injection. The cervical trunk on both sides was cut and the ends ligated. The distal trunk of the left vagus was placed on a bipolar electrode and covered with cotton wool soaked in liquid paraffin. Propranolol (1 mg/kg, i.v.) and phentolamine (2 mg/kg, i.v.) were given to block alpha- and beta-adrenoceptors. Gastric motility was recorded with a balloon introduced via the esophagus. The system was filled with water and connected to a pressure transducer, allowing measurement of changes in intragastric pressure. The initial level in intragastric pressure was set at 7 to 10 cmH₂O. The change of intragastric pressure was then recorded on a polygraph (San-ei Instrument, Tokyo, Japan) through a pressure transducer. A stimulator giving wave pulses of 10 Hz, 3 msec, 15 V for 10 S was used. The following drugs were used: pentobarbital sodium, hexamethonium bromide and gallamine triethiodide. The height of the maximum delayed contraction after treatment with...
Gallamine and hexamethonium was regarded as 100%. Statistical analysis was performed using Student's \( t \)-test for paired data.

Stimulation of the vagal trunk in cats anesthetized with pentobarbital sodium produced contraction of the stomach during stimulation (initial contraction). In 10 cats, the administration of gallamine (1 to 100 mg/kg) resulted in delayed contraction of the stomach to stimulation of the vagal trunk. Gallamine (100 mg/kg) was followed by hexamethonium (30 mg/kg), and hexamethonium (30 mg/kg) was followed by gallamine (30 mg/kg).

**Fig. 1.** Effects of gallamine on the contractile responses of the stomach to stimulation of the vagal trunk. Vertical scale indicates 20 cmH\(_2\)O; horizontal scale, 3 min. Stimulation of vagal trunk is indicated by a close circle (●). A: Gallamine (100 mg/kg), followed by hexamethonium (30 mg/kg). B: Hexamethonium (30 mg/kg), followed by gallamine (30 mg/kg).

**Fig. 2.** Induction of the delayed contraction of the stomach to stimulation of the vagal trunk by gallamine and hexamethonium. Ordinate: % response, as compared with the final response after administration of gallamine (100 mg/kg) and hexamethonium (30 mg/kg). Abscissa: dose of gallamine and hexamethonium. A: ★ indicates statistically significant difference from gallamine (100 mg/kg)-induced delayed contraction, by Student's \( t \)-test (\( P < 0.01 \)). B: ★ indicates statistically significant difference from hexamethonium (30 mg/kg)-induced delayed contraction, by Student's \( t \)-test (\( P < 0.01 \)).
kg) induced a contraction after stimulation (delayed contraction) in a dose-dependent manner (Figs. 1A and 2A). The delayed contraction reached a maximum after administration of 100 mg/kg of gallamine, and the subsequent administration of hexamethonium (1 to 30 mg/kg) further augmented the delayed contraction dose-dependently (Figs. 1A and 2A). In the other 10 cats, the administration of hexamethonium (0.3 to 30 mg/kg) induced a delayed contraction in a dose-dependent manner (Figs. 1B and 2B). After the maximum delayed contraction was induced by hexamethonium (30 mg/kg), the subsequent administration of gallamine (1 to 30 mg/kg) further augmented the delayed contraction in a dose-dependent manner (Figs. 1B and 2B).

In the previous study, electrical stimulation of the vagal trunk produced initial and delayed contractions in cats anesthetized with pentobarbital-gallamine (1, 2). In the present study, electrical stimulation of the vagal trunk in cats anesthetized with pentobarbital alone produced only the initial contraction during stimulation. The treatment with hexamethonium or gallamine induced a hexamethonium-resistant delayed contraction after stimulation. It has been reported that stimulation of the vagal trunk induces relaxation of the stomach (3, 4), and the relaxation is almost abolished by hexamethonium. This suggests that stimulation of the vagal trunk activates the hexamethonium-sensitive inhibitory neurons. Thus, the induction of the delayed contraction by hexamethonium may due to blockade of the hexamethonium-sensitive inhibitory neurons.

Gallamine does not act on the nicotinic autonomic ganglion (5). Thus, taken together with the present results, gallamine may induce the delayed contraction by a means other than those of hexamethonium. In the dog trachea, gallamine potentiates the vagal transmission, through blockade of a negative autoregulatory process (6). It is likely that gallamine induces the delayed contraction by blocking the inhibitory regulation at the vagus nerve terminals.

References