It is generally thought that an activation of baroreceptors results in an inhibition of vasopressin release, while excitation of chemoreceptors produces an increase in this hormone. Since the afferent information from the receptors is carried to the nucleus tractus solitarii (NTS), the NTS might be also involved in regulation of vasopressin release. Some investigators indeed have demonstrated that electrical stimulation of the NTS results in changes in the activity of neurosecretory cells in the paraventricular nucleus and supraoptic nucleus (1, 2). In addition, Nakai et al. (3) have shown that vasopressin-induced pressor response is elicited by electrical stimulation of the NTS in cordotomized rats.

It has been reported that kainic acid at higher doses injected into the NTS produces baroreflex blockade, probably via its depolarization blockade effect (4). In this study, therefore, we examined using this neurotoxin whether baroreflex blockade at the NTS can produce an increase in blood pressure via an augmentation of vasopressin release in rats with the spinal cord cut at C₁. Continuous intravenous infusion of 1-phenylephrine hydrochloride (1–4 µg/kg/min) with a syringe pump was used to stabilize arterial pressure close to 100 mmHg. Atropine methylbromide (2 mg/kg, i.v.) was given to block the peripheral muscarinic receptors. Body temperature was maintained 36–37°C with a heating pad and a heating lamp.

The dorsal surface of the lower brainstem was exposed as described previously (7). Microinjections into the NTS were made bilaterally 0.02 mm lateral to the caudal tip of the area postrema at a depth of 0.4 mm, which is one of the most sensitive sites to kainic acid (4). Kainic acid (Nakarai Chemicals) was given in a volume of 0.2 µl in 5 sec through a glass cannula (O.D. 100 µm), connected to a Hamilton microsyringe and a micrometer (Natsume). After termination of the experiments, the brains were fixed in 10% formalin. Frozen sections were cut (50 µm) and stained with 0.1% thionine. The location of the needle tracks was controlled microscopically. Data are reported as the mean±S.E., and Student’s t-test was used for statistical analysis of the results.

When injected bilaterally into the area of the NTS, 30 ng kainic acid produced an increase in blood pressure (Fig. 1). The pressor response began at 30–60 sec, reached a peak within 4 min after injections, and then gradually decreased and returned to control levels at 25–40 min after the injection. At a
lower dose of 3 ng, kainic acid injected bilaterally into the NTS caused a slight decrease or no change in blood pressure (−4±2 mmHg, n=5). Bilateral injections of saline (0.2 µl) into the NTS did not affect blood pressure (n=6).

In five experiments, 20 µg/kg of d(CH₂)₅Tyr(Me)arginine-vasopressin, a potent antagonist of the vasopressor response to arginine-vasopressin (8), injected intravenously 4 min after injections of kainic acid into the pressor site, abolished the pressor response within 3 min after the antagonist (Fig. 1) (Table 1). The antagonist alone caused a slight decrease in blood pressure (−6±3 mmHg, n=6). Hexamethonium (10 mg/kg), an autonomic ganglion blocking agent, injected intravenously 4 min after injections of kainic acid, did not alter the pressor response (Table 1). No changes occurred in heart rate.

The results presented here indicate that in cordotomized rats 30 ng kainic acid produced an increase in blood pressure when applied bilaterally into the area of the NTS. The pressor response could be abolished by injection of the vasopressin antagonist, but not by hexamethonium, suggesting that this response is mediated through vasopressin release.

Inhibition of the baroreceptor reflex or activation of the chemoreceptor reflex may be considered to result in an augmentation of vasopressin release. Kainic acid at higher doses produces a depolarization blockade, while in lower doses, it excites neurons in the
central nervous system (9). In the present experiments, a higher dose (30 ng) of kainic acid produced a marked increase in blood pressure when injected bilaterally into the NTS, while no pressor response was found by a lower dose of kainic acid. The pressor response to kainic acid may result from baroreflex blockade due to its depolarization blockade effect.

The vasopressin antagonist produced only a small decrease in resting blood pressure, suggesting that plasma vasopressin contributes poorly to maintenance of resting blood pressure in the cordotomized rats. That may be why at a lower dose, kainic acid injected into the NTS failed to produce significant decreases in blood pressure in the present experiments.

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