a thermogenic efferent, may be the mediator[21] of the action of the nervous system on the acute phase reaction[21,22].

To conclude, these experiments suggest that the febrile, metabolic response could be beneficial, and the rise in temperature could be harmful for the host's defences. If this is true, the animals that develop low fever at high metabolic cost would have the highest probability of surviving. The metabolic effect is, however, small. In a population of rats, a metabolic increase of 14% may improve survival by 11% points (fig. 2). Body temperature would, however, increase by 1 °C, thus reducing survival by 35% points. The metabolic effect may thus prevail only at temperatures below 38.5–39.0 °C, because the thermal effect might then be negligible. Consequently, fevers above this level seem to be detrimental for rats infected with *S. enteritidis*. An optimal fever has also been suggested for rabbits[23]; the optimal height may depend on the host species as well as on the invading microorganism[24].

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Electroacupuncture: Effects on digastric muscle activities in the rat jaw-opening reflex

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Summary. Electroacupuncture suppressed the late component of the digastric muscle activity in the rat jaw-opening reflex evoked by buccal skin stimulation, while it scarcely affected the early component. When the jaw-opening reflex was elicited by tooth pulp stimulation, the activity of the digastricus was well suppressed in its whole phase.

It has been reported that the jaw-opening reflex is produced by stimulating various oral and facial areas[2-4]. The reflex is generally considered to be the result of the activation of nociceptors or small diameter nerve fibers[2,5]. Especially when evoked by tooth pulp stimulation, the jaw-opening reflex has been regarded as a possible indicator of noxious reaction, because the tooth pulp is largely innervated by small diameter fibers[6] and also because a sensation of pain is evoked by various stimuli applied to tooth pulp or dentine[7]. However, the jaw-opening reflex can be also evoked by activation of low threshold mechanoreceptors not related to nociception[4].

On the other hand, acupuncture has been shown to suppress selectively pain sensation in patients and in laboratory volunteers[8], and noxious responses in experimental animals[9,10]. It therefore seemed interesting to compare the effects of acupuncture on the jaw-opening reflex elicited by stimulation of tooth pulp or of another oro-facial region.

Materials and methods. The experiments were undertaken with 14 female Wistar albino rats weighing about 400 g. The animals were lightly anesthetized with thiamylal sodium in an initial dose of 80 mg/kg, i.p. For afferent inputs, buccal skin and tooth pulp was electrically stimulated by rectangular constant current pulses of 0.1 msec duration at 1 Hz. Stimulating pulses were delivered to the tooth pulp of the lower incisor using a bipolar stainless steel electrode (0.1 mm in diameter, interpolar distance 2.0 mm, insulated except for the tips) inserted 20 mm from the tip of the incisor. With these conditions, intrapulpal nerve fibers mostly consisting of small diameter ones of Aδs can be selectively stimulated without eliciting a spread of current to the periodontal tissue[11]. The intensity of the stimulus pulses was about 1.5 times the threshold for producing a minimum jaw-opening reflex. The buccal skin was stimulated with the same pulses using a bipolar hook electrode of Co-Cr wire whose interpolar distance was 2.0 mm. The intensity of the pulses in this case was about 3.5 times the threshold for the jaw-opening reflex. With this intensity, both Aβ and Aδ elevations in the compound action potentials recorded from infraorbital nerve were distinguished. The electromyogram of digastric muscle in the jaw-opening reflex was recorded with a bipolar hook electrode of Co-Cr wire, interpolar distance 4.0 mm, inserted into the anterior belly of the ipsilateral digastric muscle, and its magnitude was estimated by the area of the activity. Cathodal electrical acupuncture (electroacupuncture) stimulation pulses (45 Hz, 5 msec) were delivered to the Yin-Hsiang points of both sides which are at the lateral margin of the nasolabial fold. The intensity of the electroacupuncture pulses was 5–6 times the threshold for evoking the compound action

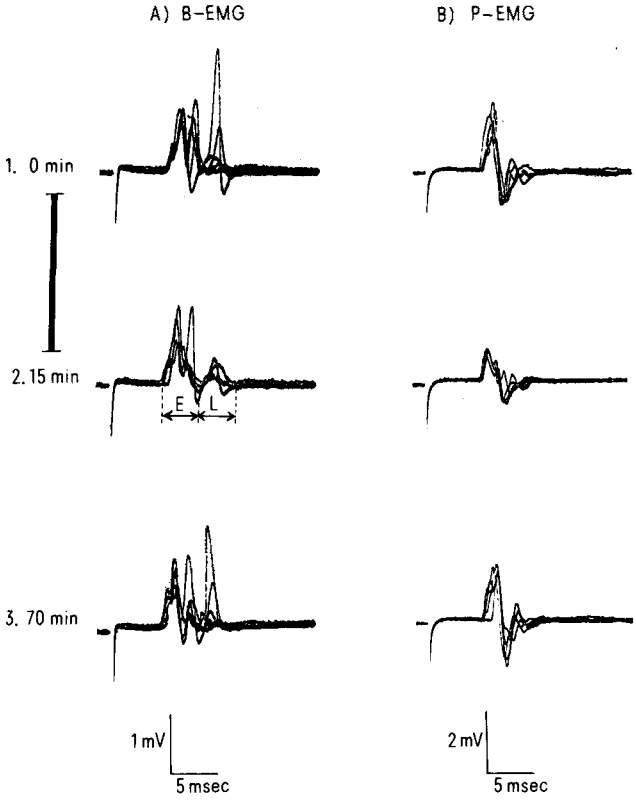

Figure 1. Typical examples of electroacupuncture effects on the buccal-evoked electromyogram of the digastricus (B-EMGs, A, left column) and the pulpal-evoked one (P-EMGs, B, right column). The B-EMGs are subdivided into early (E) and late (L) components (A-2, see text). *1)* Control. *2)* Immediately after the cessation of 15-min electroacupuncture stimulation. *3)* 55 min after the cessation of electroacupuncture stimulation. Each trace consists of 5–10 superimposed responses. Vertical bar indicates 15-min period of electroacupuncture stimulation.

potentials in the infraorbital nerve. Further details of the methods for electroacupuncture stimulation were described in the previous report[10].

Results and discussion. Typical examples of the digastric electromyogram evoked by electrical stimuli applied to buccal skin (B-EMG) and tooth pulp (P-EMG) are shown in figure 1, A-1 and B-1, respectively. The onset latency of the first component of digastric muscle activities in each case was 5.9 ± 0.7 msec (mean $\pm$ SE, $N = 14$) and 6.1 ± 0.2 msec ($N = 14$), respectively. Areas of these responses were changed by 15-min electroacupuncture stimulation applied to the Yin-Hsiang points. In the case of B-EMGs, only the late component at 10 msec was suppressed, to about 45% of the control value, while the early component was scarcely changed (B-2). Because, as shown in this case, a discontinuity in the degree of suppression can be seen at the latency of about 10 msec, B-EMGs were divided into 2 components, namely early (E) and late (L). By contrast, P-EMGs were suppressed to about 50% (A-2) of the control for the entire phase. The responses recovered to the control level within 55 min after cessation of electroacupuncture stimulation (A, B-3).

The effects of electroacupuncture on an early component (circle) and a late component (triangle) of the B-EMGs, and P-EMGs (diamond) are summarized in figure 2. The suppression was maximal 10–15 min after the onset of acupuncture stimulation, and was statistically significant

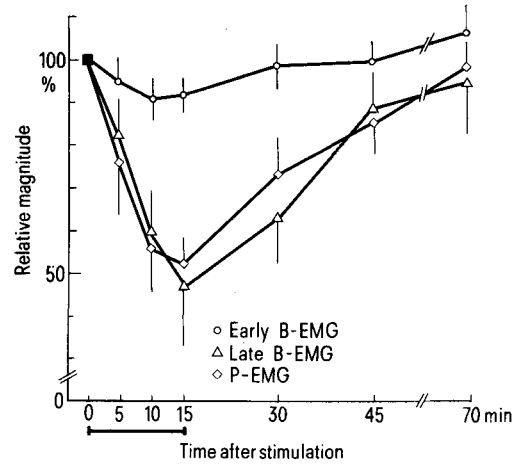

Figure 2. Time-course of the effects of electroacupuncture on the jaw-opening reflexes. ○, Early components of B-EMGs. △, late components of B-EMGs; ◇, P-EMGs. Ordinate: relative magnitude compared with the value before electroacupuncture stimulation. Horizontal bar under the abscissa indicates a period of 15-min electroacupuncture stimulation. Vertical bars indicate SE ($N = 14$).

($p < 0.05$) except for early components of B-EMGs. Further, there were no significant differences between the suppressive effects on the late component of B-EMGs and P-EMGs ($p > 0.05$). The changed responses gradually recovered to control level after the cessation of stimulation.

In the present study, digastric muscle activities in the jaw-opening reflex evoked by stimulation of the buccal skin consisted of at least 2 components, an acupuncture-effective late component and a less effective early component. Explanations of this evidence may require further investigation; however, one possible explanation for the present observation is that the early component of this reflex is produced by activation of low threshold input of Aβs and the late component is a noxious responses of Aδs. This is because a) clinical data show that acupuncture stimulation selectively suppressed the pain sensation without affecting other ones[8] and b) the degree of electroacupuncture suppression on the tooth pulp-evoked jaw-opening reflex, which is Aδ input-evoked and presumably a noxious reaction[2,5], is nearly the same as that on the late component of B-EMGs. This shows that the jaw-opening reflex evoked by the non-pulpal region is a complex response to activation of low and high threshold inputs, judging from the effective pattern induced by electroacupuncture.

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