The effects of acupuncture on muscle tissue oxygenation

Kaneko Y.[1),2)] , Kime R.[1)] , Takagi S.[1)] , Murase N.[1)], Osada T.[1)] , Katsumura T.[1)] , Kihira A.[2)] , Uehara A. [2)] , Furuya E.[2)] , Sakamoto A.[2)]

1)Tokyo Medical University, Department of Sports Medicine for Health Promotion, Tokyo, Japan
2) Kuretake College of Medical Arts & Sciences, Tokyo, Japan

Background

Acupuncture is widely used for musculoskeletal disorders such as low back pain or osteoarthritis in complementary and alternative medicine. Acupuncture is recognized as one of the reasonable referral options for chronic pain (Vickers, 2012). One of physiological effects of acupuncture is that it increases tissue blood circulation, and it may help to ease pain or hasten recovery from injuries (Kubo, 2011). Acupuncture stimulation with DeQi sensation, or manipulation increased skin and muscle blood flow in the local area (Sandberg, 2003, Ohkubo, 2009). Kubo showed the changes in blood circulation of the contralateral achilles tendon during and after acupuncture (Kubo, 2011). However, there are no previous studies of the change of blood circulation in both local and distant areas at the same time.

Objective

The aim of this study was to examine the effects of acupuncture on muscle tissue oxygenation in both local and distant areas at the same time.

Methods

Ten healthy males (29±4.1yrs, 173.7±2.7cm, 69.0±5.2kg) participated in this study. Near Infrared Spectroscopy (NIRS, HB-14, ASTEM Co.,Ltd.) (Fig. 1, 2) was used to detect oxygenated hemoglobin (oxy-Hb), deoxygenated hemoglobin (deoxy-Hb), total hemoglobin (total-Hb), and tissue-oxygen saturation (StO_2). The probes of NIRS were placed on the right and left side of erector spinae at S1 level (RS1, LS1), the right side of erector spinae at L4 level (RL4), and the belly of gastrocnemius on the right (RG) (Fig.3). Subjects lay on their belly and rested. The acupuncture needle (0.25*50mm, SEIRIN Co. ltd.) was inserted into the right side of erector spinae at S1 level, then manipulated for 1 min and left for 9 min (Fig.4). Subjects continued to rest for 10 min after removal of the needle. oxy-Hb, deoxy-Hb, total-Hb, and StO_2 were evaluated at rest (Pre) and after acupuncture stimulation (Post) (Fig. 5).

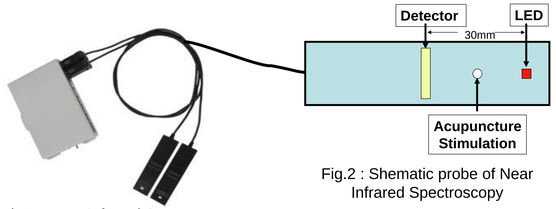


Fig.1 : Near Infrared Spectroscopy
(HB-14, ASTEM Co.,Ltd. Japan)

Fig.2 : Shematic probe of Near Infrared Spectroscopy

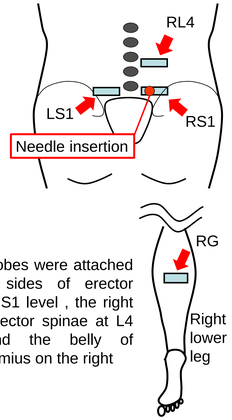


Fig.3 : Probes were attached on both sides of erector spinae at S1 level , the right side of erector spinae at L4 level, and the belly of gastrocnemius on the right

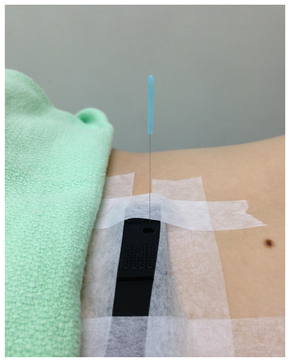


Fig.4 : Needle was inserted between LED and detector at 15mm depth.

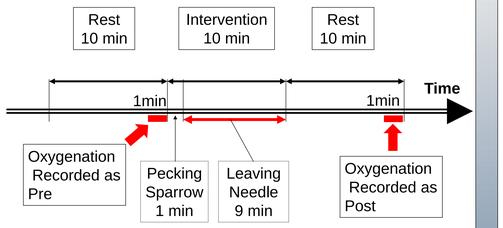


Fig.5 : Schematic protocol describing the experimental design and procedure.
Subjects had a needle inserted on the right side of erector spinae at S1 level, then received pecking sparrow manipulation for 1 min at 15mm depth and the needle was left at 15mm depth for 9 min. Recording of oxygenation was started from 10min prior to the intervention and continued to 10min after the removal of the needle.

Results

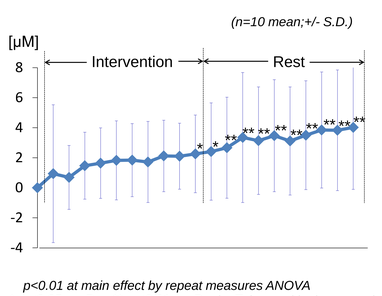
At RS1, where the needle was inserted, oxy-Hb was increased from 39.8 ± 11.7 μM to 43.9 ± 12.8 μM ($p<0.01$). No change was observed in deoxy-Hb (8.0 ± 4.1 μM to 7.9 ± 4.5 μM). Total-Hb was increased from 47.8 ± 14.1 μM to 51.8 ± 15.5 μM ($p<0.05$). StO_2 was increased from 83.8 ± 6.0 % to 85.4 ± 6.1 % ($p<0.01$). At LS1 oxy-Hb was increased from 30.6 ± 9.6 μM to 32.7 ± 10.5 μM ($p<0.05$). No change was observed in deoxy-Hb (7.6 ± 3.7 μM to 7.6 ± 3.9 μM). Total-Hb was increased from 38.2 ± 13.0 μM to 40.3 ± 14.1 μM ($p<0.05$). No change waas observed at StO_2 (80.9 ± 5.2 % to 82.0 ± 5.1 %). At RL4 oxy-Hb was increased from 36.1 ± 7.8 μM to 41.0 ± 9.2 μM ($p<0.01$). No change was observed in deoxy-Hb (8.5 ± 4.4 μM to 8.9 ± 3.6 μM). Total-Hb was increased from 44.1 ± 11.0 μM to 49.8 ± 12.3 μM ($p<0.01$). StO_2 was increased from 81.2 ± 5.1 % to 82.8 ± 4.2 % ($p<0.05$). At RG oxy-Hb was increased from 77.7 ± 34.2 μM to 80.7 ± 36.6 μM ($p<0.05$). deoxy-Hb was increased from 27.4 ± 7.7 μM to 28.7 ± 7.4 μM ($p<0.05$). Total-Hb was increased from 105.2 ± 40.3 μM to 109.2 ± 42.3 μM ($p<0.01$). There was no change in StO_2 (72.8 ± 4.9 % to 72.4 ± 5.5 %) (Table. 1, Fig. 6,7).

(n=10 mean ± S.D.)

	oxy-Hb		deoxy-Hb		total-Hb	
	Pre	Post	Pre	Post	Pre	Post
RS1	39.8 ± 11.7	43.9±12.8**	8.0 ± 4.1	7.9 ± 4.5	47.8 ± 14.1	51.8 ± 15.5*
LS1	30.6 ± 9.6	32.7 ± 10.5*	7.6 ± 3.7	7.6 ± 3.9	38.2 ± 13.0	40.3 ± 14.1*
RL4	36.1 ± 7.8	41.0 ± 9.2**	8.5 ± 4.4	8.9 ± 3.6	44.1 ± 11.0	49.8 ± 12.3**
RG	77.7 ± 34.2	80.7 ± 36.6*	27.4 ± 7.7	28.7 ± 7.4*	105.2 ± 40.3	109.2 ± 42.3**

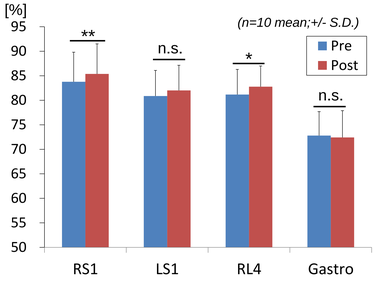
**: p<0.05 vs. Pre, **: p<0.01 vs. Pre by paired student-t test*

Table 1: The change of oxy-Hb, deoxy-Hb, and total-Hb at Pre and Post. There were significant changes in oxy-Hb and total-Hb at all areas. At gastrocnemius, deoxy-Hb was also increased after the intervention while no changes were observed in other areas.



p<0.01 at main effect by repeat measures ANOVA
**: p<0.05 vs. Pre, **: p<0.01 vs. Pre by Tukey multipule comparison*

Fig. 6 :This graph shows the increase of oxy-Hb from Pre to Post at RS1. There are significant differences at the end of intervention and in the whole period of resting after the intervention compared to Pre.



**: p<0.05 vs. Pre **: p<0.01 vs. Pre by paired student-t test*

Fig. 7 :The changes in StO_2 at Pre and Post. StO_2 was increased after the intervention at RS1 and RL4 while no change was observed at gastrocnemius.

Conclusions

Different effects of acupuncture on muscle tissue oxygenation were observed where the acupuncture needle was inserted in local area and distant areas. These results indicate that acupuncture stimulation may differently affect local and distant areas, such as by axon reflex and by segmental effects via sympathetic nervous system.

References: *Vickers et al., Arch Intern Med. 2012; 172(19):1444-1453.*
Sandberg et al., Eur J Appl Physiol 2003; 90:114-9.
Ohkubo et. al., Dynamic Medicine 2009; 8:2.
Kubo et al., Int J Sports Med. 2011 Oct; 32(10): 807-13.