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Effects of Back Massages on Stress Observed in Students Preparing for the National License Examination

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Abstract

We measured serum level of cortisol and lactate, the stiffness of trapezius, skin blood flow and VAS before and after the back massages of 25 senior college students, who had sent stressful days for 11 months starting from April, preparing for the national license examination. These students usually had complaints of stiffness of shoulder and/or lumber. Back massages significantly reduced the level of serum cortisol from 8.85 ± 0.78 to 5.95 ± 0.68 μg/dl, without affecting that of lactate. The treatment also improved the stiffness of the trapezius of students with complaints from 63.24 ± 0.78 to 59.12 ± 0.78 after the treatment without affecting skin blood flow (SKBF). In addition, back massages reduced the VAS value at the same time. These results indicate that back massages of the student are effective to improve the physical and psychological conditions of the students.

Keywords

Back Massages, Serum Cortisol, Serum Lactate, Chronic Stress, The National License Examination for Medical Technologist

1. Introduction

Medical technologists greatly support everyday medical services mainly through the various examinations by biochemical, physical, hematologic, serologic or microbiologic methods under the instructions of medical or

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dental doctors.

According to the law of Japan, the medical technologists need a national qualification [1]. The national license examination for medical technologists is held once a year at the end of February, and the examination is a sort of hard barrier for the students and success rate was 77.2% in 2013. Although the most students finished their job hunting before the examination, students are not able to engage in the job as medical technologist without passing the examination. They usually start to prepare the examination from April of the senior grade. In particular, just before the national examination, they have to spend many hours for the preparation sitting in a chair for 6 to 8 hours per day. In addition under these situations, the students before the examination have to spend stressful days with a feeling of unrest and strain for a long period, and usually have complaints of stiffness of shoulder and/or back as a stress-syndrome.

In an attempt to improve the physical and psychological conditions of the students, we have been measuring stress markers including serum cortisol [2]-[4] and serum DHEA-S [5] as the longterm biomarkers for the stress, before and after the treatment with hot pack of students. It turned out that hot pack treatments of the students significantly reduced the level of serum cortisol without affecting that of lactate and the level of plasma DHEA-S, and enhanced the skin blood flow of the shoulder although the treatment did not significantly improve the stiffness of the trapezius of students with complaints [2]-[5].

To find out better treatments to release the physical and psychological stress of the students facing national examination, this time we applied back massages [6] [7] and observed the effects on serum cortisol, the skin blood flow of the shoulder, stiffness of the trapezius and Visual Analog Scale (VAS). The obtained results were compared to that of hot pack treatments [3] [4].

Therefore, the new aspect of the present study is to examine the link between the physical treatment (back massages) and psychological condition of the students from a physiological point of view.

2. Methods

2.1. Subjects

Thirty two healthy students of clinical medical technology department in Kumamoto Health Science University participated in this study. They were 21 or 22 years old men (19) and women (13) with stiffness of shoulder and/or lumber. The students were examinee of national license examination as clinical medical technologist and they were ready for the examination to be held next month.

2.2. Ethical Consideration

All experimental procedures were conducted in accordance with the Declaration of Helsinki. The subjects were informed of the experimental risks and signed an informed consent document approved by the Human Subject Research Committee of the Kumamoto Health Science University and submitted the document prior to the investigation.

2.3. Back Massages of the Subjects

Back massages were applied to students once a day for 30 days, from 6 to 7 P.M. during the middle of January to February at Basic Research Practice Room.

Back massages were performed according to the methods described elsewhere for 30 minutes [6] [7]. Namely, the area of the back massages was the spinous processes and medial border of the scapula between second to fifth cervical spine, neck and shoulder.

The massaging maneuver was rubbing the area with three fingers (index, middle and third finger) putted together, making forms of loop, at acupressure between 400 - 800 g, which was adjusted to be comfortable for subjects. As shown in **Figure 1**, firstly the loop like massages were applied according to the midline between the second to fifth cervical line, and then both sides (1, 2 in **Figure 1**). One loop like massages takes 5 - 10 seconds. Secondly, the loop like massages were applied to the medial border of the scapula, then posterior part of the neck and shoulder for 3 minutes (3, 4, 5). Finally the massages were applied to the area between the ilium for 10 minutes (6).

During massages the subjects were in the lateral decubitus or supine positions, and without conversation with

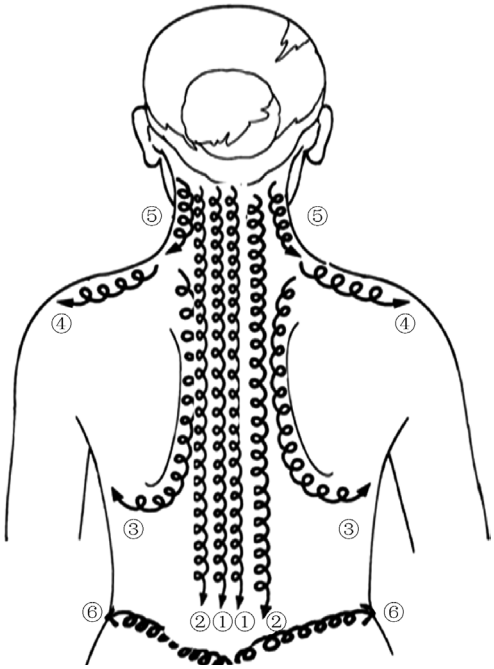

Figure 1. Practical method of back massages.

therapist except the adjustment of the finger pressure.

2.4. Blood Serum Cortisol Value

In general, the reaction to stress takes the form of two series of reactions: hypothalamic-pituitary-adrenal cortex (stimulation of the endocrine system) and hypothalamic-pons-medulla-spinalcord-adrenal medulla (stimulation of the autonomous nervous system). The blood serum cortisol value used here is useful as an indicator of stress, measured in endocrine system cortisol [8]. Although the cortisol concentration increases in relation to psychological stress, the cortisol secretion was reported to fall when pleasant stimuli occur [9]-[11]. Students are engaged in long periods of study in preparation for national examinations. We measured the blood serum cortisol levels prior and subsequent to the application of back massages in order to investigate changes in the students' stress levels.

Namely, the level of serum cortisol before and after 30 minutes treatment with back massages according to the methods described elsewhere [2]-[4].

2.5. Measurement of Lactic Acid in the Blood

Lactic acid levels in the blood rise with exercise. Westudied changes in the levels of lactic acid in the blood, while students were engaged in learning activities and maintaining the same position for long periods of time, as well as when they went to bed for the back massages. The oxygen method (LO-PDC) [12] was used to test the level of lactic acid in the blood. The blood for testing was taken from the median cubital vein.

2.6. The Measurement of the Stiffness of Trapezius

We used the PEK-1 (Imoto machinery Co., LTD) to assess stiffness of trapezius according to the method described elsewhere [13]. The subjects turned to the front in seat rank with both hands on knee, and then we measured the stiffness of trapezius at the central point between the seventh cervical spinous process and outer end of acromion three times, and used the mean value as the value for stiffness of the muscle.

2.7. The Measurements of the Skin Blood Flow

We used skin rheometer LASER DOPPLER ALF21N (ADVANCE CO, LTD) to study the blood flow 6 mm

under the skin [14]. By use of ALF21N, we measured three times the skin blood flow before and after the back massages treatments, at almost the same points where we measured the stiffness of the trapezius, and used the mean value as the skin blood flow.

2.8. VAS (Visual Analog Scale)

At the end of the study, we asked the subjects to assess VAS which is a psychological measure to evaluate the body condition as set into 10 degree from pleasant (1 point) to unpleasant (10 points). The room temperature was 25˚C ± 2˚C, and natural sounds without conversation.

2.9. Data Analysis

We used a non-parametric Wilcoxon signed-rank test, Stat View (ABACUS Concepts, Inc, Berkley, CA) for statistical analysis before and after the application of back massages. All data were expressed as the mean ± SE, and values of $p < 0.05$ were considered as significant.

3. Results

3.1. Serum Level of Cortisol

Figure 2 shows that back massages reduce the mean values of serum cortisol from 8.85 ± 0.78 (ranging between 5.00 to 19.40 μg/dl) to 5.95 ± 0.68 μg/dl (ranging between 3.20 to 18.10 μg/dl) ($p < 0.05$), after the treatment.

3.2. Serum Level of Lactate

Contrary to the effects on cortisol, back massages did not show any effects on the serum level of lactate as shown in **Figure 3** (1.13 ± 0.08 (ranging between 0.6 - 1.9) and 1.17 ± 0.06 mmol/l (ranging between 1.9 - 0.6) before and after the treatments respectively) ($p > 0.05$).

3.3. Stiffness of Trapezius

Back massages significantly reduced the mean values of the stiffness of the trapezius from 63.24 ± 0.78 (ranging between 72.0 - 57.0) to 59.12 ± 0.78 (ranging between 66.0 - 53.0) ($p < 0.05$) (**Figure 4**).

3.4. The Measurement of Skin Blood Flow at Shoulder

The mean values of the skin blood flow before and after the treatment with back massages were 0.19 ± 0.02 (au) (ranging between from 0.07 to 0.63) and 0.41 ± 0.13 (au) (ranging between from 0.08 to 2.10) respectively, thereby indicating that the treatment slightly increased the skin blood flow, however the increase was statistically not significant ($p > 0.05$) (**Figure 5**).

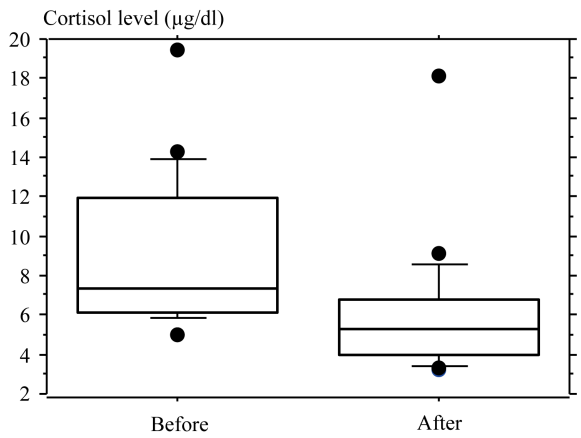

Figure 2. The box plot of mean values of serum cortisol before and after the back massages.

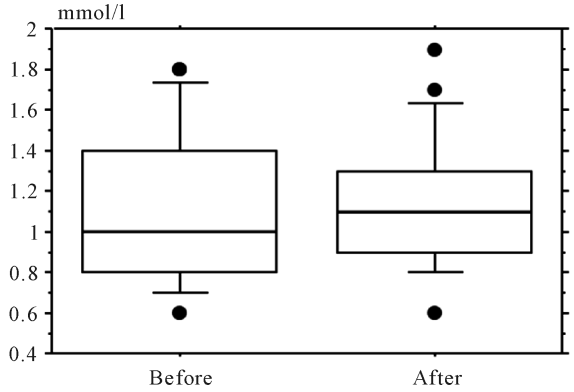

Figure 3. The box plot of mean values of serum lactate before and after the treatment.

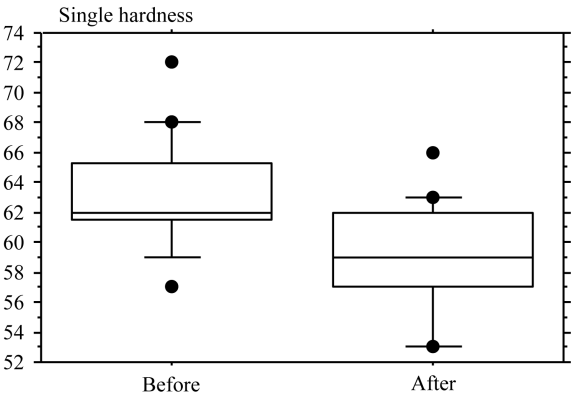

Figure 4. The box plot of mean stiffness of muscular trapezes before and after the treatment.

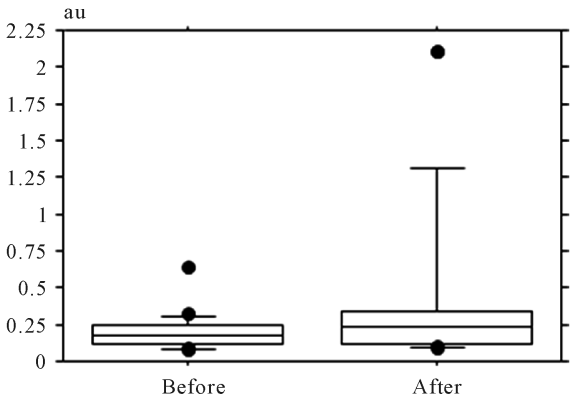

Figure 5. The box plot of mean skin blood flow before and after the treatment.

3.5. VAS

Figure 6 shows the effects of back massages on the mean VAS values. The treatment significantly reduced the mean value from 5.00 ± 1.68 (ranging between 2 - 7) to 2.2 ± 1.99 (ranging 0 - 7).

4. Discussion

Recently, many human biologists have shown increasing interest in the use of cortisol as an objective marker for

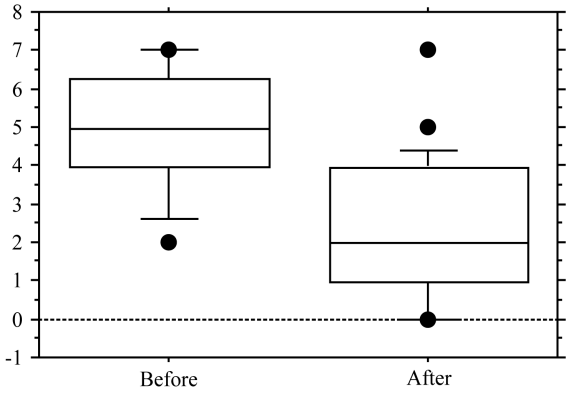

Figure 6. The box plot of mean VAS values before and after the treatment.

stress, and the level of cortisol in urine, plasma, or saliva can be measured [15] [16]. Furthermore, the use of hair cortisol as a chronic state of biological maker has been proposed in the recent studies [17] [18]. Till now, however, the level of salivary cortisol has been routinely used as a biomarker for psychological stress and related mental or physical diseases, since sampling salivagives no stress and methods readily measuring a bioactive substance in the saliva are available at present [19]. However, the psychological mechanisms, which trigger the hypothalamus-pituitary-adrenal axis (HPAA) can only indirectly be assessed by salivary cortisol measures [15], since the salivary secretion is controlled by sympathetic and parasympathetic nervous system. Therefore, in the present study we measured the level of serum cortisol before and after the treatment of the students.

Concerning the methods to relief stress, on the other hand, massages, hot pack treatment or music therapy [20] are available at present. Previously, we reported that breast and shoulder massages are effective to relief stress during the puerperium [6] [7].

Therefore, in the present study, we observed the effects of back massages on the serum level of cortisol in the students who are going to take the examination within a month in an attempt to examine whether back massages is effective to relief the physical and psychological stress of the students.

We found that the back massages of the students significantly reduce serum level of cortisol without affecting that of lactate. This observation is in accordance with our previous results obtained by use of hot pack treatments of the students [2]-[4]. The importance of the removal of lactate from the exercised muscle for recovery of performance originates from the earlier studies indicating that intracellular acidosis contributes to muscle fatigue [21] [22]. Recent studies indicate that lactate is an important intermediary in numerous metabolic processes rather than the direct cause of acidosis, referred as “lactic acidosis” in the muscle [23] [24]. Power exercises such as sprinting, when the rate of demand for energy is high, glucose is broken down and oxidized to pyruvate, and lactate is produced from pyruvate faster than the tissue can remove it, so lactate concentration begins to rise. Therefore, blood lactate concentration reflects the balance between lactate production and clearance [25]. Thus, we measured the serum level of lactate as a marker for the muscle fatigue, since the students kept the same position for a long time. However, the serum level of lactate was not affected at all after the back massages as in the case of hot pack treatment [3] [4]. This would be due to that the students were lying down in the bed during the treatment.

It turned out that back massages reduce the stiffness of trapezium, but did not change the skin blood flow at all, although hot pack treatments increase the skinblood flow without affecting the muscle stiffnesss. These different results may be due to the property of the stimuli, namely mechanical (massages) and heat (hot pack treatment) stimuli.

Massages have been defined as “a mechanical manipulation of body tissues with rhythmical pressure and stroking for the purpose of promotion health and well-being” [26]. From the view point of athletes and sports medicine personnel, it is generally believed, based on observations and experiences, that massage can provide several benefits to the body such as increased blood flow, reduced muscle tension and neurological excitability, and an increased sense of well-being, although empirical data on possible mechanisms involved are limited [27]. Furthermore, there are number of techniques in existence, and their use depends on the experience and skill of

the therapist and intended clinical advantage desired.

The massaging maneuver used in the present study was rubbing the back with three fingers putted together, making forms of loop, at acupressure between 400 - 800 g. It is generally considered that massages evokes two types of responses, namely mechanical responses as a result of pressure and movement as the soft tissues are manipulated and reflex responses in which the nerves respond to stimulation. In the present study, it seems that mechanical massages directly relieved muscular stiffness with no change in SKBF. In addition massages also reduced the VAS value, and therefore, it seems reasonable to assume that both mechanical and reflex responses are involved in the present results obtained by back massages, although the exact mechanisms in the present observations are yet to be clarified.

Back massages of the students did not affect the skin blood flow at all in the present study. Concerning the effects of massages on the blood flow in the musculature or skin, till now there are bulk of reports, and a common belief among athletes and therapists alike has been that massage enhances muscle blood flow [28]. However empirical data, presented during last decade, were equivocal. Firstly, it was reported that blood flow increased by 50% after vigorous massage [29]; however, later studies claimed much smaller increases [30]-[32] or no increase at all [33].

Recent studies performed by modern techniques with both Doppler ultrasound and laser Doppler flowmetry to integrate femoral artery blood flow (FABF) and skin blood flow (SKBF), do not support the hypothesis that postexercise massage elevates limb blood flow [34]. Namely, massages applied to the quadriceps significantly elevated skin blood flow (SKBF) without the increase in femoral artery blood flow (FABF), questioning the efficacy of massage as an aid to recovery in postexercise settings. Furthermore, recent study indicates that massage even impairs post exercise muscle blood flow by mechanically impeding blood flow [35].

However, there is a solid physiological basis for predicting that massages could elevate muscle blood flow on the basis of recent findings of rapid vasodilatory responses of resistance vessels to repeated compression [36]-[38]. Thus, further studies are definitely warranted concerning the effects of massages on the blood flow in the patients with stiffness or the athlete after the exercises.

Our previous and present studies indicate that hot pack treatment but not the massages of the back affected the skin blood flow. Hot pack treatment of the students reduced the serum level of cortisol and VAS value at the same time, indicating that the treatment could relief mainly psychological stress [3] [4]. It was also observed the decrease in VAS values in response to hot pack treatment [39].

From a psychological point of view, Butagat *et al*. also reported that hot pack treatment could increase the feeling of comfort and enhance relaxation [40]. However, it is unknown whether the hot pack treatment increases the arterial blood flow or not in the back. Thus, under the assumption that the some muscle blood flow diverted into the cutaneous circulation, then the increase in the skin blood flow might question the hot pack effects to cure the stiff shoulder or the neck. It is generally considered that SKBF mainly plays an important role in thermoregulation of the body (see for example [41]).

Taking all these experimental facts into the account, it seems that massages may be better treatment rather than hot pack treatment of the students with physical and psychological stresses.

However, further studies are definitely warranted to understand the mechanisms involved in the effects of massage on physical and psychological responses, due to limitations of the present study.

5. Conclusion

Back massages of the students, preparing for the national license examination, significantly reduced the muscle stiffness of trapezius, serum level of cortisol without affecting that of lactate and VAS value, thereby indicating that the treatment is effective to improve the physical and psychological conditions of the students.

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