CHAPTER V

DISCUSSION AND CONCLUSIONS

The subjects in this research are male university-athletes aged between 18 - 28 years old, including the athletes in basketball, football, rugby, swimming, polo, teakwando, and athletics. The 57 subjects were divided into 3 groups : (1) active recovery (AR) group (n=18), performed on a bicycle ergometer at 30%VO_2max after the exercise, (2) massage recovery (MR) group (n=20), received Traditional Thai massage (TTM) after exercise, and (3) passive recovery (PR) group (n=19), used the passive recovery by taking the rest alone after the exercise. Each kind of sports chosen for studying uses similar energy. After the study, it was found that VO_2max level of the subjects in all groups, measured during the test had no significant difference as follows : AR, MR and PR were 49.51 ± 7.07, 50.47 ± 7.05 and 48.09 ± 5.71 ml/kg/min, respectively.

The physiological effect of massage have been attributed to: 1) an increase in local circulation, 2) an increase in cellular permeability and 3) the soothing effect it has on central and peripheral nerves (Gupta et al., 1996). Some recent studies indicate that massage results in an earlier recovery than rest alone as it is accompanied by an increase in the total circulating blood volume by shifting plasma (Kresge,1985), red blood cell (Kresge,1985), haemoglobin (Arkko,1983), while other studies have reported that the use of massage has no such benefits, at least in respect to quicker lactate elimination or raised circulating blood cell volume (Boone et al.,1991; Tomasik,1983). However, the responses described by Burke (Burke, 1999) suggested better removal of lactate from the muscle cells and an increase in the transport of lactate in systemic circulation.

In the present experiment, the highest lactate value was found at 5 min after the end of exercise in all modes of recovery, and subsequently declined at 10 min, although not significantly. This indicates that the massage does not have any extra advantage in enhancing the diffusion of lactate in the different body compartments in the first 5 minutes. In view of the present observations, it could be stated that peak lactate may be reached in 0 to 10 min after repeated sessions of supramaximal exercise, and that massage may be considered ineffective for the faster removal of LA from the muscles. Previous studies have indicated that [LA] reaches peak at level between 2 to 7 min (Gupta et al., 1996; Astrand et al., 1988; Fujitsuka et al., 1982; Sjodin et al., 1976) after the cessation of short bursts of supramaximal exercise. It has also been stated that a 3 min period of recovery is not sufficient for establishing an equilibrium between the active muscle and the passive areas of lactate space (Freund et al., 1990).

According to the study result of AR, MR and PR group, it was found that the mean of blood lactate concentration in recovery periods decreased at 5 min (10.73, 11.03 and 12.17 mmol/l), 10 min (9.11, 9.37 and 11.43 mmol/l), 15 min (7.56, 8.05 and 9.75 mmol/l), 20 min (5.95, 6.62 and 7.98 mmol/l) and 30 min (3.56, 4.95 and 5.98 mmol/l), respectively. That was so because blood lactate concentration during the intensive exercise would be increased, depending on the intensity of work and slowly decreased in the rest period, and it took 60 min or more in order to decrease the concentration to the rest level (Astrand and Rodahl, 1986). Fox and Mathew, 1981 have reported that 95% of lactic acid will be removed and turned to the rest level within hour and 15 min after the peak exercise. However, McArdle (McArdle et al., 2000) reported that, after the exercise, it must take 20 min for the passive recovery in order to remove a half of congested lactic acid. And in comparison the blood lactate concentration after exercise between MR and PR group, it is found that, in the recovery period which are 5, 10, 15, 20 and 30 min, the mean of blood lactate concentration of MR group is less than that of PR group. According to the 5 min

recovery, however, there is no significant difference at .05 level while in the 10, 15, 20 and 30 min recovery, it is found that there is significant difference at .05 level according to the hypothesis that the result of TTM can remove more lactic acid in blood than the rest alone. This indicates that it needs more than 10 minutes for the massage in obviously decreasing lactic acid in blood.

The technique of TTM was similar to the deep massage. Goats (Goats, 1994) states that the deep massage stimulates the body to release histamine and acetylcholine, which help in vasodilatation, enhancing blood flow, and increased stroke volume reflects improved venous return. Goats and Keir (Goats and Keir, 1991) suggest that deep massage results in the increase of blood flow through limb and it also enhances the lymph flow. Moreover, it helps lymphocyte moves 8 times faster. Shoemaker and worker (Shoemaker et al.,1996) have reported 10-20% of lactic acid are transferred to Kreb's cycle and electron transport system and results in $CO_2 + H_2O$ and energy, while 80-90% of it are changed into glycogen kept in muscles and liver instead in order to be used as the energy. This process is called Cori cycle (Fox and Mathews, 1981). Likewise, Burke (Burke,1999) has reported that some oxygen in blood turn the lactic acid into glycogen and some generate ATP+CP.

AR shows the shortest half life and it is obvious that the time required for oxidation of lactate would be smaller than gluconeogenesis. An increased cardiac output, VO_2 and lactate oxidation may be responsible for a shorter life in AR, as compared to MR and PR. The first detectable difference in the removal of lactate found in the case of AR at 10 min is indicative of the utilization of lactate as a substrate for energy production in later stages of recovery. Exercise at 30% of VO_2max may also raise the temperature of the muscle (Astrand and Rodahl, 1986), hence a similar amount of excess VO_2 for AR supports this view.

But, in MR such an increase in VO_2 is unrelated to lactate kinetics, as lactate removal in MR is similar to PR. However, based on these data it is not possible to confirm that an increase in VO_2 during MR is possible. The total quantity of CO_2

produced during the recovery period was lower than the amount of oxygen consumed in all cases as being an absolute fact, since AR has shown higher CO_2 output in a relative sense. This higher CO_2 production may be taken into account if there was also a decrease in the alkali reserve. The major consumer of LA in the body included relatively inactive muscle (Brooks, 1991). Considering the proposed role of massage in enhancing the circulation and permeability, the whole body should have received the massage to increase the consumer muscle mass. However, in that case each portion of the body would have received a massage for only 5 min, which may not be sufficient. It was thought better to increase the duration of massage (Gupta, 1996).

In the present experiment, AR considered a much better recovery process than MR ($p > 0.05$) and PR ($p < 0.05$), particularly when faster rate of lactate elimination is the main criterion.

From studies in AR, MR and PR group, it is found that the mean of heart rate will be highest after the exercise at 0 min (181, 182 and 185 bpm) and will immediately decrease after the recovery. In the 30 min recovery, the heart rate decreases at 5 min (125, 101 and 110 bpm), 10 min (119, 95 and 103 bpm), 15 min (116, 89 and 99 bpm), 20 min (114, 84 and 95 bpm), 25 min (113, 82 and 91 bpm) and 30 min (111, 79 and 89 bpm), respectively. The heart rate will rapidly decrease after the end of exercise, caused by chemical absorption of the muscles and joints, and will decrease to the rest level. According to Lamb (Lamb, 1984), the athletes who exercise in long period and then terminate due to fatigue can be able to slowly recover their heart rate to normal. Some of them may take 1-2 hours before the heart rate will be decrease to the rate prior to the exercise, that is, the chemical concentration in the body fluid decreased to the rest level. And in the comparison between MR and PR group, it is found that the mean of heart rate of MR group is significantly less than that of PR group ($p < 0.05$), in accordance with the hypothesis that TTM results in declining the heart rate more effectively than the rest alone. This indicates that TTM has a part in faster decreasing the heart rate to the rest level prior to the test as the massage helps in

better circulation, enhancing local circulation, and cellular permeability of capillary (Chindewa, 1996). Consequently, the circulation can deliver the oxygen to the muscles and get the waste off the muscles better, that is, the stroke volume increases and, therefore, the heart rate decreases (McArdle et al.,1996). In addition, Cararelli and Flint (Cararelli and Flint, 1992) have supported that getting the massage after the exercise decreases the heart rate. This study had different between position sitting at recovery period between MR and PR group. Posture of MR at received TTM similar with long sitting, which to position effect on increased blood flow and decreased heart rate.

In conclusion, TTM results in faster recovery, particularly in regards to the decrement of heart rate to the rest level, than the rest alone.

In addition, effects of TTM to nervous system, TTM promote pressure through skin down to dorsal root ganglion via dorsal horn of spinal cord and pass through ascending pathway to thalamus and ending in cerebral cortex. During pathway through brain stem it will synapse to reticular formation net work which will affect to vasomotor center and enhance vasodilatation.

An alternative pathway via synapse of affector fiber and neuron in lateral gray matter, and effecter to internal organ in sympathetic system and effect to movement of visceral organ is called " somato – visceral reflex".

The techniques of TTM differ from that of the universal massage as follows.

1. Press and release technique; while being pressed, the feeling of pain and tightness will be occurred, followed by the feeling of relaxation after released. The light press on capillary stimulates capillary permeability, resulting in the vasodilatation, and consequently enhancing circulation.

2. The certain pressed-points in TTM; if the masseur presses on the correct points, the lactic acid will be effectively removed. The knowledge of the points is

another traditional science, agreeing to the meridian line in Chinese massage which is expected to result in enhancing the circulation.

The advantages of TTM

1. Lesser techniques are used in TTM than in the universal massage.
2. As the body weight is used in supporting the press, the masseur does not need to apply much energy for the massage, resulting in less exhaustion, wrist and finger movement.
3. TTM has certain pattern.
4. TTM is Thai intellectual.

However, the limitation is the knowledge of masseur concerning anatomy, pathophysiology of disease and insufficient training.

Conclusions

It is concluded from the study that the TTM is effective in enhancing the lactate removal and that an active type of recovery is the best modality for enhancing lactate removal after exercise. And the result of TTM taking more than 10 minutes obviously causes the difference in removing lactic acid in blood than the rest alone.

Recommendation from the study

According to the study conducted on the effect of TTM on lactic acid removal and recovery, it is found that massage used in all kinds of sport and it results to faster recovery. The massage can be used during the provided brake or time brake in the competition rounds. For example, athletics and swimming have 30 minute time brake up. And TTM can be used while taking the rest during the game, which is 10 to 20

minutes, such as basketball, football, rugby, and hockey. The major consumer of LA in the body includes relatively inactive muscle (Burke, 1999). Considering the proposed role of massage in enhancing the circulation and permeability, the whole body should have received the massage to increase the consumer muscle mass. However, in that case each portion of the body would have received a massage for leg massage, which may not be sufficient. It was thought better to increase the whole body massage and the duration of massage. In addition, this study if subjects received TTM applied massage around the active muscle to direct, such as hamstring and quardicep muscle, immediately after bicycle pedalling, may be effectively better than standard pattern.

In using the massage, it should be considered that there must be no muscle inflammation on the massage area, otherwise more inflammation can occurr. Therefore, the masseurs must be expert and well trained so that the athletes get the top benefit from the massage.

Recommendation for further study

1. Study TTM and compare its result on lactic acid removal and recovery, obtained by means of massaging all over the body in different periods, like an hour recovery period.

2. The effect of TTM on physical performance after the recovery should be studied.

3. The result of getting TTM pre-competitions should be conducted by different ways, like body warm-up and stretching.

4. The study of getting TTM post-competitions should be conducted by different ways, like relaxing by light exercise.