Efficiency evaluation of mud applications of laser doppler of skin

S K Kasimova¹, E I Kondratenko¹, O M Alykova¹, N A Lomtieva¹ and A F Alykova²

¹Astrakhan state university, Astrakhan, Russia
²National Research Nuclear University MEPhI Moscow Engineering Physics Institute), Moscow, Russia

E-mail: saule_kasimova@mail.ru

Abstract. The mechanism of the microcirculation's change of the face skin of the women under the influence of the sulfur silt mud application of the lake Karantinnoe of Astrakhan region was studied. The age particularities of vasorelaxation's peloid action on the microcirculation of the face skin was installed. Peloid promotes the influx of arterial blood, the improvement of the tissue's feeding and the reduction of the stagnant events. The prolonged action of the sulfur silt mud application reveals at more mature age.

1. Introduction
The Laser Doppler flowmetry (LDF) noninvasive method is highly effective in diagnostics of a condition of the microcirculator course of skin including studying changes of microcirculator processes using mud applications [3]. The studied sulphidic and silt therapeutic mud is extracted from the lake Karantinnoe located in the western part of the delta of the Volga River, in Limansky district of the Astrakhan region and according to the Balneological conclusion of FSU «RNCVM&KRossdrav» № 14/186 from 4/20/2007 is recognized as medical.

2. Methods
Examinees were divided into 4 age groups [1]. In total, 40 people participated in an experiment. Studying of microcirculation of face skin was carried out by means of the laser analyzer of rate of a superficial capillary blood flow "LAKK-01" (production of NPP Lazma, Russia, the registration certificate № 29/030200703/5555-03 of 11.09.2003). Measurements were performed in the center of the right cheek and in the center of a forehead (at the height of 1 cm from brows). Each measurement was performed within 4 min. that is sufficient for registration of necessary quantity of cycles of change of PI (perfusion index). Measurements were taken before drawing mud application, through 5 and in 15 min. after mud application. Application time – 10 min., temperature of the mud used for application, 30°C. In the first age group studying of change of microcirculation of a skin in 5 min. after processing of a skin by normal saline solution for assessment of mechanical impact on it was carried out. In this work the analysis of functioning of the active mechanisms caused by myogenetic activity of vazomotor (AmaxLF/M) and neurogenic influences (σ/AmaxLF) and also the passive mechanisms caused by cordial (AmaxCF/σ) and respiratory rhythms of a regulation of a blood flow.
(AmaxHF/σ) was carried out. Calculated the index of efficiency of microcirculation (IEM) – the integrated characteristic of a blood flow between active and passive mechanisms of a regulation of a blood flow in system of microcirculation: IEM=AmaxLF/(AmaxHF+AmaxCF). Also the rheologic factor (intravascular resistance, AmaxCF/M) was considered.

3. Results

Wiping of face skin physiological solution had no significant effect on perfusion indicators of fabric, but increase in a tone of vessels has been testified. Thus, it is possible to exclude influence of manipulations with skin on microcirculation change.

At registration of an indicator of microcirculation of face skin after mud application at first the tendency to increase in perfusion (in 5 min.), then to reduction was observed (in 15 min).

Table 1. Change of microcirculation of face skin in a cheek at women of different age groups

| Indicators                      | Before mud application | In 5 min. after mud application | In 15 min. after mud application |
|---------------------------------|------------------------|---------------------------------|---------------------------------|
|                                 | first age group, 16-25 years, n=10 |
| M, perfusion units              | 18,08±1,662            | 19,20±1,789                     | 18,96±0,981                     |
| σ, perfusion units              | 1,02±0,124             | 1,40±0,165                      | 1,33±0,196                      |
| Kv, %                           | 5,36±0,558             | 7,50±0,627*                     | 6,01±0,598                      |
| IEM, %                          | 1,42±0,127             | 1,40±0,093                      | 1,17±0,120                      |
| Intravessel. resistance, %      | 1,11±0,169             | 1,60±0,256                      | 1,53±0,252                      |
|                                 | Second age group, 26-35 years |
| M, perfusion units              | 17,68±1,017            | 19,82±1,931                     | 19,41±1,233                     |
| σ, perfusion units              | 1,36±0,162             | 1,04±0,112                      | 1,03±0,056                      |
| Kv, %                           | 6,01±0,531             | 4,76±0,139                      | 5,37±0,375                      |
| IEM, %                          | 1,31±0,128             | 1,17±0,085                      | 1,37±0,133                      |
| Intravessel. resistance, %      | 1,12±0,122             | 0,94±0,075                      | 1,28±0,086                      |
|                                 | Third age group, 36-45 years |
| M, perfusion units              | 18,6±1,69              | 18,2±1,54                       | 23,0±2,31                       |
| σ, perfusion units              | 0,8±0,11               | 1,2±0,18                        | 1,2±0,16 *                      |
| Kv, %                           | 4,6±0,53               | 6,8±0,77 *                      | 5,6±0,68                        |
| IEM                             | 1,4±0,13               | 1,2±0,14                        | 1,4±0,12                        |
| Intravessel. resistance, %      | 0,92±0,138             | 0,92±0,061                      | 0,86±0,058                      |
|                                 | Senior age group, 46-55 years |
| M, perfusion units              | 18,6±1,69              | 18,2±1,54                       | 23,0±2,31                       |
| σ, perfusion units              | 0,8±0,11               | 1,2±0,18                        | 1,2±0,16 *                      |
| Kv, %                           | 4,6±0,53               | 6,8±0,77 *                      | 5,6±0,68                        |
| IEM       | 1,4±0,13 | 1,2±0,14 | 1,4±0,12 |
|-----------|----------|----------|----------|
| Intravessel. resistance, % | 0,92±0,138 | 0,92±0,061 | 0,86±0,058 |

Notes: * - differences in comparison with measurements before mud application; ** - p≤0,01, *** - p≤0,001; # - differences in comparison with measurements in 5 min. after before mud application; ## - p<0,01, ### - p≤0,001

Practically the efficiency index didn't change, it was only slightly decreasing in 15 min. The amplitude-frequency analysis showed that in case of the normal state of face skin the active mechanism of regulation prevails. Increase of a contribution of vazomotion in 5 min. (p<0,05) with its further decrease is fixed (p≤0,01 – in 15 min.). The same tendency was observed in case of change of a vascular tone. In that time, there was a decrease in the regulating influence of the passive mechanism.

Figure 1. Change of microcirculation of face skin in a cheek at girls volunteers of 16-25 years (1 – before drawing before mud application, 2 – after physiological solution, 3 – in 5 min. after before mud application, 4 – in 15 min. after before mud application, 5 – after course application of before mud application, here and to figure 2)

In this case, if in 5 min. the active mechanism exerted impact, then in 15 min. it was replaced by action of passive. Intra vascular resistance after mud application had a downward tendency.

In the second age group after drawing mud application in a cheek the tendency to growth of an indicator of microcirculation was shown that was followed by decrease in mean square value and coefficient of a variation (tab. 1). At the same time in case of the first measurement after application decrease in an index of efficiency of microcirculation which by 15th minute was recovered to reference values is noted.

In the analysis of a contribution of various mechanisms to change of microcirculation the tendency similar to the previous age group in case of which in the fifth minute decrease in influence of vazomotion, a vascular tone and intra vascular resistance while compound the passive mechanism strengthen the influence is fixed is traced.
In the 15th minute a little ambiguous picture as there is a further decrease in a vascular tone and respiratory fluctuations comes to light, and influence of pulse fluctuations and vazomotion (fig. 2) in parallel increases. When studying microcirculator processes of face skin in cheeks at women of 36-45 years after 5 min. after application changes of the main indicator of microcirculation of M (tab. 1) weren't revealed. In 15 min. after mud application the tendency to increase in this indicator was observed that was followed by increase of a mean square deviation ($p<0.05$).

The variation coefficient in the fifth minute increased for 48% ($p<0.05$), further there was a
decrease in this indicator. IEM practically didn’t change throughout measurements. By means of the amplitude-frequency analysis the tendency to decrease in influence of the passive mechanism after mud application has been revealed. At the same time decrease of the activity of the smooth muscle cells and intra vascular resistance was observed (fig. 3). Obviously, the decisive factor explaining the increasing fabric perfusion is strengthening of a vascular tone which in 5 min. increases for 26% (p<0,05) and in 15 min. remains at the level, exceeding control values for 21%.

Changes of microcirculation of face skin in a cheek of women of the senior age group (46-55 years) as a result of mud applications had the following character: already on the 5th min. the tendency to growth of an indicator of M which continued to increase has been recorded, and on the 15th min. exceeded control values for 34% (p<0,05).

These changes were followed by increase of values of such indicators as \( \sigma \), IEM (tab. 1). At the same time, the intra vascular resistance and coefficient of a variation tended to decrease in rather previous measurements.

![Figure 4](image)

*Figure 4. Change of microcirculation of face skin in a cheek after mud application at female volunteers of 46-55 years*

As we can see from the fig. 4, change of microcirculation of face skin in a cheek at women of this age group in inverse proportion to change of respiratory fluctuations, i.e. their level decreased after mud applications. At the same time the nature of change of a vascular tone and pulse fluctuations had an identical tendency: increase on the 5th mines with further reduction. Exactly the opposite there was an activity change of the smooth muscle of cells.

Having carried out the comparative analysis of nature of change of microcirculation of face skin of female volunteers of different age after drawing mud applications (fig. 5), it is possible to note the following:

1. in the first age group (16-25 years) there is an insignificant increase in an indicator of M after mud applications;
2. this indicator increases in the second age group (26-35 years) for 12, 4% in 5 min. after mud application and 9.79% in 15 min. rather initial measurements;
3. in the third age group (36-45 years) of change are noted in 15 min., at the same time force of influence of mud application directed to increase of an indicator of M has made 11% (p<0,05);
4. mud application had the most expressed effect in the senior age group (46-55 years) where the M indicator in 5 min. increased for 21.66% (force of influence of mud application has made 13%, p<0.05) and for 33.77% – in 15 min. after application (force of influence has made 31%, p<0.001).

![Figure 5](image-url) Change of microcirculation of face skin of female volunteers of different age groups as a result of mud applications

4. Conclusions

Thus, effect of sulphidic mud of the lake Karantinnoe is shown as improving microcirculation and in redistribution of influence of factors of active and passive mechanisms. Applications of a peloid promote inflow of arterial blood to the nutritive course of face skin and outflow venous, i.e. to decrease in probability of developments of stagnation. These changes are more expressed at measurement in 5 min. after mud application at volunteers of younger age group. With age, as well as in the analysis of indicators of thermometry, the prolonged action of mud application is shown, i.e. change of microcirculation is fixed later (in 15 min. after mud application) [2]. On the basis of the conducted researches it is possible to draw the following conclusions:

1. strengthening of microcirculation noted by reliability of distinctions before mud applications happens in the senior age groups (36-45 and 46-55 years);
2. these changes are connected, first of all, by increasing of muscular activity and respiratory fluctuations.

References

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