

COPARATIVE SIGNIFICANCE OF THE PRINCIPAL FACTOTS RESPNSIBLE FOR MICRPOCIRCULATORY DISIRDERS IN TYPE 2 DIABETES MELLITUS

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The present study was aimed at investigating the comparative +changes of the two most significant microcirculatory factors if microvascular blood flow, possibly producing severe disorders in blood supply to tissues in the diabetic patients – constriction of resistant arteries and the hemorheological disorders in the patients with the type 2 diabetes mellitus. By using direct quantitative and highly sensitive investigation techniques we found that insulin improves the blood rheological properties in the microcirculation altered during diabetes. However, when the disorders are strongly pronounced, due to enhanced red blood cells (RBC) aggregation, e.g., during development of the feet diabetic gangrene, the insulin becomes inefficient. As to the arteriolar tone, it seems to play less significant role in the pathogenesis of microcirculatory disturbances in diabetic patients.

Key words: Erythrocyte aggregation, diabetes mellitus, resistance of arteries

Diabetes mellitus is characterized by severe circulatory disorders leading to such complications as the cardiac infarcts, diabetes retinopathy, feet gangrene and many others. The type 2 of the disease means that the tissues loose their normal reactivity to insulin.

The microcirculatory disorders during diabetes mellitus might be both regional and systemic, produced by two principal causes, namely changes of the microvessels diameter, on the one hand, and the blood rheological disorders, on the other. Among the latter an essential role is played by enhanced erythrocyte aggregation, while the others (RBC deformability, local hematocrit and the blood plasma viscosity) seem to play a less significant role [9].

Unclear nature the microcirculatory disorders, as well as lack of adequate techniques for their investigation restricted so far the better understanding of the microcirculatory disorders and the mechanisms of pathological changes in the tissues.

MATERIALS NAD METHODS

For a better understanding of the both microvascular and hemoreheological factors altering the microflow in tissues of the diabetes patients we applied the most reliable techniques. In this way we attempted to obtain the direct and quantitative data about the blood flow disorders in microvessels of the patients with the type 2 diabetes mellitus.

In the same diabetic patients we investigated the actual changes of the two most significant microcirculatory indices that might produce a deficiency of blood supply to the tissues. This was the RBC aggregability ("Georgian Technique") producing the blood rheological disorders in microvessels[7]. On the other hand, we investigated the resistance of arterial tone by using our original technique [6]. Both techniques provided us with direct and quantitative data.

RESULTS AND DISCUSSION

In the diabetic outpatients, which were not treated with insulin, the RBC aggregability was found considerably increased as compared to the healthy control group, where the insulin returned the RBC aggregability to the normal level (Fig.1, left three columns). Prior to surgery in the patients with developed foot diabetic gangrene the RBC aggregability was very high, elevated about twice as compared to the normal value, notwithstanding the insulin treatment (Fig.2).

Fig. 1 RBC aggregability in blood of diabetic patients untreated and treated with insulin ($p < 0.001$)

In the diabetic patients the arteriolar resistance index was increased against the healthy control group, but the rise was considerably smaller than that of the RBC aggregability (Fig.3). In summary, comparison of the quantitative deviations of the hemorheological and resistive arterial changes evidenced that of the index of hemorheological disturbances raised approximately three times over that of the arteriolar constriction.

Two principal mechanisms can be involved in the reduction of microcirculation in any organ or tissue of the patient's body. These are the constriction of the resistive arteries and disturbance of the blood fluidity in the microvessels [11]. The human extremities provided us with a possibility to investigate these two variables quantitatively with the appropriate techniques.

Fig.2. RBC aggregability in the venous blood flowing from the foot with developed diabetic gangrene, as compared to the healthy control ($p < 0.001$).

Fig.3. Comparison of the arteriolar resistance index in healthy controls and in patients with diabetes mellitus ($p < 0.001$)

We found that in the investigated patients increase of the blood rheological disorders exceeded about four times the rise of the tone of the resistive arteries. Significance of these results becomes even more evident if we take into account that among various hemorheological factors it is just the RBCs enhanced aggregability that is the most potent factor disturbing the blood rheological properties in the microcirculation [8].

Further, the present study shows that following the effect of insulin in the investigated +diabetic patients the enhanced erythrocyte aggregability decreased significantly. This demonstrated also in the *in vitro* conditions and therefore existence of such an effect is undoubted. However, its mechanism during diabetes remains so far unclear [5,10].

The present studies evaluating and demonstrating the microcirculatory phenomena most reliable because they were evaluated by us with both direct and quantitative techniques showing the actual functional changes almost as reliably as in the artificial models. Unlike the blood rheological disorders, which could be evaluated in the blood samples only as a systemic phenomenon (because blood is uninterruptedly circulating and mixing together in the circulatory bed), the functional state of the resistive arteries could be determined directly (I.e. most reliably) only in certain circulatory regions, e.g., in the patients hands, as it was evidenced in the present study.

One of the most essential problems to be solved in future is an immediate cause and the mechanism of increased erythrocyte aggregability during the diabetes mellitus. This problem is essential because the blood rheological disorders produced the gravest complications of the diabetes mellitus such as the lower extremity gangrene, the diabetic retinopathy, and the cardiac infarcts [1,2,3,4].

The pathophysiological mechanism of the majority of microcirculatory disorders, specifically of the hemorheological nature, which are well known during the diabetes mellitus, have not active in the patients with the diabetic gangrene?

REFERENCES

1. Dahl-Jorgensen K., Brinchmann-Hansen O., Hansen K.F., Ganes T., Kierulf P., Smeland E., Sandvik L., Aagenaes O. Br. Med. J. 1986, 293, 5-9
2. Dintenfass L. Angiology. 1974. 23, 365-372
3. Dintenfass L. Rheology of Blood in Diagnostic and Preventive Medicine. London, Boston. 1976. - 396
4. Engerman R.L. Kern T.S. Metabolism. 1986. 35, 20-23
5. Lauritzen T., Frost-Larsen K., Larsen H.W., Deckert T. Diabetes, 1985. 34, 74-79
6. Mantskava m., Mchedlishvili G., Elkin S., Pargalava N., Kotaria T., Tsinamdzgvrishvili B. In: Pathophysiology of microcirculation and Homeostasis 9N. pertishchev, ed.) Sanct-Peterbourg. State Medical University Publishers. 1998. 323-331
7. Mchedlishvili G., Beritashvili N., Lominadze D., Tsinamdzgvrishvili B. biorheology. 1993. 30, 153-161
8. Mchedlishvili G. Clinical Hemorheology and Microcirculation. 1998. 19, 161-162
9. Mchedlishvili G., hakarishvili R., Momtselidze N., Gobejishvili L., Mantskava M. Clinical Hemorheology and Microcirculation. 2000. 22, 9-15
10. Stout R.W. Diabetologia, 1979, 16, 141-150
11. Webb D.J., Collier H.G., Seidelin P., Struthers A.D. J. hyperten., 198. 3, 57-59

მიკროცირკულაციის დამრღვევი ძირითადი ფაქტორების შეფასება II ტიპის შაქრიანი დიაბეტის დროს

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რეზიუმე

კვლევის მიზანს წარმოადგენდა მიკროცირკულაციის ძირითადი მახასიათებლების და სავარაუდოდ, ქსოვილთა სისხლით მომარაგება-ის დარღვევის გამომწვევი ფაქტორების ცვლილებების შედარებითი ანალიზი. კერძოდ, რეზისტული არტერიების კონსტრიქციის და ჰემორეოლოგიური დარღვევების შეფასება II ტიპის დიაბეტის მქონე პაციენტებში. პირდაპირი, რაოდენობრივი და მაღალმგრძობიარე მეთოდების გამოყენებით ჩვენს მიერ დადგინდა, რომ ინსულინი აუმჯობესებს სისხლის რეოლოგიურ თვისებებს დიაბეტის პირობებში დაზიანებულ მიკროცირკულაციის სისტემაში. მაშინ როდესაც ამგვარი დარღვევები მკვეთრად გამოხატულია გაძლიერებული აგრეგაციის გამო, მაგ დიაბეტური განგრენის ფონზე, ინსულინის ზემოქმედება საკმარისი აღარაა. რაც შესხება არტერიოლების მომატებულ ტონუსს დიაბეტის დროს, მისი მონაწილეობა ამ დაავადების პათოგენეზში და მიკროცირკულაციის დარღვევების ჩამოყალიბებაში უმნიშვნელოა.

СРАВНИТЕЛЬНОЕ ЗНАЧЕНИЕ ОСНОВНЫХ ФАКТОРОВ, ОТВЕТСТВЕННЫХ ЗА МИКРОЦИРКУЛЯТОРНЫЕ НАРУШЕНИЯ ПРИ ВТОРОМ ТИПЕ ДИАБЕТА

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РЕЗЮМЕ

Цель настоящих исследований состояла в в сравнения основных факторов, определяющих микроциркуляционную, возможно, нарушающих кровоснабжение тканей, а именно, констрикции резистивных артерий и гемореологических расстройств у пациентов со вторым типом сахарного диабета. Используя прямые, качественные и высокочувствительные методики, было обнаружено, что инсулин улучшает реологические свойства крови в системе микроциркуляции, которые бывают нарушенными при диабете. Однако, когда эти нарушения очень выражены, вследствие усиленной агрегации Эритроцитов, например при развитии диабетической гангрены нижних конечностей, эффект инсулина оказывается недостаточным. Что же касается тонуса артериол, его изменения представляются сравнительно незначительными в патогенезе микроциркуляторных нарушений у диабетиков.