

Ultrasonic diagnosis of peripheral angiopathies in diabetes mellitus

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The review deals with data on the significance of early diagnosis of vascular complications of diabetes mellitus and a conclusion is made about the promising character of ultrasonic examination for revealing structural and functional changes of arterial vessels and for assessing microcirculation.

Key words: *diabetes mellitus, angiopathy, ultrasonic diagnosis*

In recent decades actually all countries of the world have been involved by a pandemic of diabetes mellitus (DM) [27]. If in 2013 there were 382 million patients with diabetes registered in the world, by 2030 its prevalence will have increased by 54% [26]. Vascular complications of DM, the so-called macro- and microangiopathies, which affect vessels of the microcirculation territory and arteries of the retina, kidneys, heart and lower extremities, are the most dangerous and prognostically unfavourable. It is vascular complications that eighty per cent of deaths in DM are attributed to; coronary disease (CD), stroke and diseases of peripheral arteries are the most significant of them [10]. Their opportune diagnosis and treatment are the most important direction in preventing severe disability and fatal outcomes [24].

One of the leading places among the most frequent and severe complications of DM is taken by peripheral angiopathies and neuropathies [4, 6], particularly "diabetic foot". The latter is the major cause for amputation of lower extremities as result of pyonecrotic lesions and gangrene of foot. The risk of extremity amputations in DM increases almost 25 times [6, 19].

The structure of vascular complications of lower extremities contains microangiopathies, caused by capillary lesions, and macronagiopathies, which result from atherosclerosis of arteries on lower extremities, including Monckeberg's sclerosis [8, 17]. Involvements of distal arteries, most commonly of the tibial and fibular ones, in combination with microangiopathy are accompanied with diffuse ischaemic lesions of soft tissues, which necessitate incapacitating surgical interventions [2, 6, 14, 20, 23]. Development of these complications is also facilitated by arterial hypertension, dyslipidaemia and central obesity, which develop in patients with DM [20].

Early diagnosis of such lesions is of paramount importance from the viewpoint of the illness prognosis, but this is not always possible by signs and symptoms owing to peculiarities in clinical manifestations. Extremely significant in such cases are instrumental methods of diagnosis, ultrasound taking a specific place among them. Deviations in some indices of ultrasonic examinations can reveal before any typical clinical manifestations, thereby making it possible to assess risks of complications and prognosis of the disease.

Unquestionable advantages of ultrasonic examinations are as follows: noninvasiveness, absence of any harmful effects on the organism, possibility of repeated, including multiple, dynamic examinations as well as their low cost [3]. The state of arterial territories is assessed with help of ultrasonic duplex scanning of lower extremity vessels (USDS) and Doppler M-

mode ultrasonography (DUSG). USDS makes it possible to visualize a blood vessel, assess the state of its wall, lumen, presence of atherosclerotic plaques, aneurysms and other pathological formations in B-mode, while DUSG makes it possible to observe in the real-time mode the flow distribution in an artery, to assess in M-mode the extent of pulsation of a vascular wall, to carry out spectral analysis of the Doppler signal, to determine peak systolic, end-diastolic, average and volume velocities of blood flow, resistance index and pulsation index. The above provides a rather complete characteristic of blood flow in major arteries of extremities [3, 6]. In recent years there have reports about the necessity to assess qualitative characteristics of atherosclerotic plaques. Signs of atherosclerotic plaque instability make it possible to reveal patients with a high risk of severe vascular complications, particularly stroke [28].

It should be mentioned that the traditional protocol of ultrasonic examination of peripheral arteries at initial stages of the disease before the development of stenosis gives little information. Assessment of the ankle brachial index is widely used for early detection of peripheral angiopathy and recommended as a screening test in high-risk patients [9].

It should be taken in consideration that in recent years the main group of patients with DM has consisted of children, young people and those at the mean age, who have not got any atherosclerotic lesions yet, as well as that microangiopathy is the major cause of peripheral circulatory disturbances. Detection of microangiopathies with help of instrumental methods requires specific approaches.

In order to assess the intensity of diabetic microangiopathy it is suggested to study muscular microcirculation using ultrasonic examination with contrast enhancement [12]. Contrast enhancement during ultrasonic examination of vessels makes it possible to assess the state of the adventitia membrane of major arteries; in particular patients with DM revealed lesions of the vasa vasorum of carotid arteries [22].

Assessment of the intensity of microangiopathies is another direction in the improvement of diagnosis of vascular lesions. The resolving power of modern ultrasonographs does not make it possible to visualize capillaries directly. For their examination indirect methods of functional estimation are used. It has been revealed that endothelial dysfunction is one of the first signs of microangiopathies and the first manifestation of the atherosclerotic process. Endothelial dysfunction facilitates development of arterial wall stiffness and underlies the further evolution of atherosclerosis. Endothelial dysfunction has been shown to act as a predictor of cardiovascular pathology [21].

Endothelial dysfunction is regarded as an inadequate and uncontrolled formation of various biologically active substances in the endothelium and as an important link in the pathogenesis of atherosclerosis, hypertensive disease, CD, DM [7, 15]. It has been revealed that disturbances in glucose metabolism, typical for DM, are also accompanied with endothelial dysfunction and an increase of arterial stiffness

[16], DM complications being endothelium-dependent [10].

The functional activity of endothelium is estimated on the basis of study of endothelium-dependent or endothelium-independent vasodilatation under the effect of different stimuli: pharmacological, test with reactive hyperaemia, test with cold or mental stress, etc. The assessment of the vasomotor function is based on the estimation of the effect of a stimulus on the diameter of a vessel and blood flow along it. Usually, acetylcholine is used as a pharmacological stimulus, while temporary occlusion of a vessel followed by estimation of the flow-dependent response of the major vessel to ischaemia is a common mechanical stimulus. Intra-arterial injections of acetylcholine are considered to be the "gold standard" in the assessment of endothelium-dependent vasodilatation and used mainly in patients with arterial hypertension or hypercholesterolaemia and in nephrological cases [7, 15].

In order to register blood flow changes in different vascular territories high-frequency Doppler ultrasonography or laser flowmetry [18] is used. The injection of a vasoactive agent is followed by the study of blood volume velocity in tissues with help of a high-frequency sensor. The main shortcoming of the acetylcholine test consists in its invasiveness, i.e. the necessity to inject acetylcholine intra-arterially. That is why some Russian authors suggested the method of injection of an active substance with help of iontophoresis. The informativity of the study was sufficient, but the method was rid of invasiveness [5]. Also widespread became the method of assessment of vasodilatation after the sublingual administration of nitroglycerine [1, 18, 21].

Assessment of the arterial wall stiffness by study of the intima-media complex is another method for early estimation of angiopathic disturbances. In particular, an increased

thickness of the intima-media complex of the external carotid artery, which is easily accessible for examination, is an early sign of atherosclerosis [11]. It has been shown that the intima-media thickness is a strong predictor of cardiovascular events in future [25]. In their report the Russian authors listed several indices of arterial stiffness, which can be used for assessing the carotid arteries in patients with arterial hypertension and DM: elasticity coefficient, coefficient of stretch, Peterson's elastic modulus, Young's modulus and lumen deformity of arterial wall during the cardiac cycle. The above indices, particularly the coefficient of stretch and Peterson's elastic modulus, turned out to reliably increase in patients with DM and demonstrate the extent of their vascular reconstruction. Similar results were got by other authors too [13, 29].

CONCLUSIONS

Thus, vascular complications of DM should be revealed as early as possible in order to prevent disability and fatal outcomes. It is not always that clinical manifestations of these complications are clearly marked at early stages; therefore their instrumental diagnosis is reasonable in such cases. For this purpose contrast angiography is the most informative technique, but indications for its use are limited, and this examination does not give any information in microangiopathy. In this connection it is reasonable to actively use ultrasonic methods of diagnosis, which make it possible to estimate the function of vessels of different calibres, rather than their structure only. Dysfunctions appear at the earliest stages of the illness, when structural changes are absent or feebly marked. Ultrasonic examinations are useful both for diagnosing angiopathies and assessing the efficacy of treatment.

Ультразвуковая диагностика периферических ангиопатий при сахарном диабете Т.П. Лисенко

В обзорной статье приведен анализ публикаций, посвященных вопросам сосудистых осложнений сахарного диабета и методам их диагностики. Сделан вывод о перспективности ультразвуковых методов исследования для ранней диагностики диабетических макро- и микроангиопатий, как наиболее безопасного и не затратного метода.
Ключевые слова: сахарный диабет, ангиопатия, ультразвуковая диагностика.

Ультразвукова діагностика периферійних ангиопатій при цукровому діабеті Т.П. Лисенко

В оглядовій статті наведено аналіз публікацій, присвячених питанням судинних ускладнень цукрового діабету та методам їх діагностики. Зроблено висновок про перспективність ультразвукових методів дослідження для ранньої діагностики диабетичних макро- та мікроангіопатій, як найбільш безпечного та не затратного методу.
Ключові слова: цукровий діабет, ангиопатія, ультразвукова діагностика.

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НОВОСТИ МЕДИЦИНЫ

ГРУДНОЕ ВСКАРМЛИВАНИЕ УМЕНЬШАЕТ ВЕРОЯТНОСТЬ РАКА ЯИЧНИКОВ

Журнал Национального института рака опубликовал результаты исследования ученых Abramson Cancer Center при Пенсильванском университете, согласно которому грудное вскармливание или прием оральных контрацептивов уменьшают риск рака яичников у женщин, имеющих генетическую предрасположенность к таким заболеваниям.

Гены BRCA1 и BRCA2 отвечают за производство белков-супрессоров (антионкогенов) в организме. Эти белки помогают восстанавливать поврежденные ДНК и стабилизируют генетический материал клетки. Му-

тация или изменение в любом из этих генов означает, что специфические белки не вырабатываются или вырабатываются неправильно, поэтому поврежденная ДНК не восстанавливается. Это приводит к дальнейшим генетическим нарушениям в клетках, а позднее и к развитию рака.

По данным Национального института рака, мутации вызывают около 15% всех случаев рака яичников. Около 39% женщин наследуют мутации генов, вызывающих рак яичников в возрасте до 70 лет.

Ученые обнаружили, что женщины, унаследовавшие мутационный

ген и кормящие грудью, имели гораздо более низкий риск развития рака яичников по сравнению с женщинами, которые не кормили грудью или перенесли процедуру перевязки маточных труб. Исследователи сообщили, что оральные контрацептивы так же снижают вероятность заболевания раком яичников, однако прежде чем начать принимать противозачаточные препараты, необходимо проконсультироваться с гинекологом.

По материалам
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