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USING ULTRASOUND STUDIES TO ASSESS OBESITY AS A RISK FACTOR FOR CARDIOVASCULAR DISEASE

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For many decades' obesity has been one of the main risk factors for the development of cardiovascular pathology. Despite the work of scientists and doctors of various specialities, the burden of this pathology continues to increase its contribution to morbidity and mortality from cardiovascular diseases. Numerous anthropometric criteria of obesity are well studied, simple and inexpensive means of diagnosing overweight in the population. However, their accuracy is relatively low. In particular, body composition, which is key to cardiovascular risk stratification, cannot be determined using these criteria. Despite the relatively short period of use of ultrasound methods for the diagnosis of obesity, convincing evidence of their high accuracy and effectiveness in predicting cardiovascular risk has already been obtained. Given the continuous improvement of ultrasound machines, the criteria considered should be incorporated into routine clinical and research practice.

This literature review considers the main parameters used in ultrasound diagnosis of obesity, their contribution to the development of both traditional risk factors and directly cardiovascular diseases.

Key words: obesity, ultrasound diagnosis, cardiovascular diseases, risk factors, visceral fat.

Obesity is a major risk factor (FR) for mortality and morbidity worldwide [1]. The number of obesity-related deaths has increased threefold over the past decade and currently accounts for almost 28 million deaths each year [2]. At the same time, almost 70% are caused by cardiovascular disease (CVD) [1].

Obesity is a chronic disease associated with various metabolic disorders, the prevalence of which is constantly increasing in both children and adults. It has been proven that adipose tissue is capable of secreting inflammatory mediators including interleukin-6, -1β, tumour necrosis factor-α, leptin, which subsequently reduce

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adiponectin production, thereby inducing a pro-inflammatory state. In obesity, adipose tissue synthesises and releases large amounts of hormones and cytokines that alter metabolic processes, contributing to atherosclerotic plaque formation. Endothelial dysfunction is an initiator of CVD progression in obesity [3]. Due to association with other risk factors, overweight and obesity contribute to the development of CVD and coronary heart disease (CHD) in particular [4].

In most studies, obesity is more commonly described using body mass index (BMI) [2]. BMI is a practical and convenient measure for identifying obesity in clinical practice and epidemiological studies, but does not reflect the distribution of adipose tissue [5].

While BMI reflects the combination of fat and muscle mass, anthropometric parameters such as waist circumference (WC) and waist-hip index (WHI) are markers of central obesity. According to some researchers, OT and OT/HB are more indicative of an unfavourable metabolic profile compared to BMI [6, 7]. Another indicator, visceral adiposity index (VIA), is not yet popular enough among researchers and practitioners, but it has already established itself as a reliable indicator of adipose tissue dysfunction and the risk of cardiometabolic diseases. Thus, an increase in BMI more than BMI or OT was associated with myocardial infarction, intima-media complex thickness, disorders of carbohydrate metabolism and renal function [8].

It has already been proven that obesity, defined on the basis of BMI alone, is a heterogeneous condition with different cardiovascular and metabolic manifestations in different individuals. Adipose tissue is an extremely active metabolic organ involved in interactions between different systems, and its increase contributes directly or indirectly to CVD. Inadequate increase in subcutaneous adipose tissue on the background of eating disorders leads to visceral and ectopic fat deposition, inflammatory adipokine dysregulation and insulin resistance. Conversely, the distribution of adipose tissue in the lower body depot may act as a metabolic buffer and protect other tissues from lipotoxicity caused by excess lipids and ectopic fat [9].

Anthropometric indices such as BMI, OT, OT/OB, and BMI are widely used to diagnose obesity due to their ease of use, low cost, and lack of radiation exposure. However, given the differences between body mass components, the use of these indices alone does not always reconstruct a complete picture, which consequently makes adjustments in cardiovascular risk prediction [10, 11].

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Today in clinical practice and research work, radial methods of adipose tissue visualisation are increasingly used - magnetic resonance imaging (MRI), computed tomography (CT), densitometry, ultrasound (USG). Their undoubted advantage is their high accuracy in differentiating fat deposits. However, along with the advantages, there are also limitations. For example, MRI and CT scans are expensive and have high radiation exposure. Densitometry has high accuracy along with CT and MRI, is relatively inexpensive, does not carry a high radiation load, and is the leading method for diagnosing osteoporosis. However, in many regions there is still a shortage of devices, so the method has not gained popularity in the diagnosis of obesity. Ultrasound is an inexpensive method that avoids radiation exposure, but its accuracy and reliability are still debated. Also, the lack of standardised protocols, age and ethnic norms may be an obstacle to the widespread adoption of this method in clinical practice [10, 12].

Therefore, the aim of this review was to analyse ultrasound parameters of obesity for the purpose of cardiovascular risk stratification.

One of the first and most studied parameters used in the ultrasound assessment of obesity is intraabdominal adipose tissue thickness (IAFT) assessed using a convex transducer (3.5-5 MHz). However, there is no consensus on which anatomical parameters should be considered as a reference for ultrasound [10, 13, 14]. Most researchers measure IAFT from the posterior wall of the rectus abdominis muscle (i.e., from the linea alba) to the anterior wall of the aorta [12, 14-16]. Other authors have measured IAFT from the rectus abdominis muscle to the anterior wall of the lumbar spine, the posterior wall of the aorta or the lumbar muscle [10, 11, 14], or as the distance between the peritoneum and the lumbar region [14]. Measurements were always performed in the supine position with arms along the body. Some scientists have shown that technical aspects play an important role in the accuracy and reproducibility of measurements: it is very important to perform measurements on an empty stomach, on the breath, and to control the pressure of the transducer on the skin [16].

In general, most authors agree that IAFT is better suited for the assessment of regional obesity and shows good prognostic value for the detection of CVD risk [20].

The Abdominal wall fat index (WFI) is one of the most widely used sonographic indices for regional assessment of obesity. It is calculated as a ratio of two values: preperitoneal fat thickness (PFT)/minimum subcutaneous fat thickness (MinASFT). These parameters are assessed with a linear transducer in the upper abdomen with a

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longitudinal scan along the midline, just below the median process, as the basic distance between the anterior surface of the peritoneum covering the liver to the posterior surface of the white line (preperitoneal fat thickness) and the distance between the anterior surface of the white line and the skin-fat barrier (minimum abdominal subcutaneous fat thickness). Based on WFI, obesity can be categorised into visceral (WFI >1) and subcutaneous (WFI <1) types [10].

Preperitoneal fat thickness (PFT). PFT was introduced by Suzuki R, et al. in 1995 as part of WFI [21]. It is assessed using a linear transducer (7.5 MHz) placed longitudinally at the level of the medulla as the maximum distance between the anterior surface of the peritoneum covering the liver and the posterior surface of the white line [14].

In addition, recent studies have shown that PFT can predict the presence and severity of CHD and could be associated with arterial stiffness in obese adolescents [23].

Subcutaneous adipose tissue (SAT). Two parameters are used to measure SAT thickness by ultrasound: MinASFT (minimum subcutaneous fat thickness) and MaxASFT (maximum abdominal subcutaneous fat thickness) [14, 24]. MinASFT is measured with a linear transducer (7.5 MHz) as the distance between the anterior surface of the white line and the skin-fat barrier (hypodermis) [17, 24].

Epicardial adipose tissue (EAT) thickness. EAT is part of the visceral adipose tissue located between the heart and the pericardium. Because of its anatomical proximity to the coronary arteries, increased EAT thickness actively contributes to the development and progression of coronary atherosclerosis. EAT has endocrine, paracrine, vasocrine and inflammatory effects and is associated with metabolic syndrome, insulin resistance, CHD and arterial hypertension. Consequently, the measurement of EAT thickness has gained importance in identifying the risks of CHD progression [37-39]. There is evidence of an association between EAT and cardiofibrosis. Thus, an increase in EAT thickness of the left and right ventricles by 1.33-fold and 1.34-fold, respectively, increases the risk of myocardial fibrosis in patients with myocardial infarction [42].

In general, ultrasound is a fast, inexpensive and widely available technology that has not yet been fully utilised in the diagnosis of obesity, even though it has been demonstrated to be highly accurate and capable of differentiating visceral and

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subcutaneous fat depots and assessing organ (liver and muscle) fat stores. The association between visceral fat thickness measured by ultrasound and metabolic FRs of CVD is more pronounced than the association between these factors and anthropometric parameters (BMI and OT) [10, 11].

Ultrasound can be performed from an early age, making this technique a valuable method to assess possible obesity-related FRs at a very early stage and in individuals of any body weight. Furthermore, an additional advantage is the possibility to assess the quality of skeletal muscle, which is useful in the diagnosis of sarcopenia in the elderly [10, 11].

Thus, the considered body fat content indices determined by ultrasound are very accurate and effective in predicting cardiovascular risks. At the same time, there are a number of issues related to the insufficient study of this method. The role of subcutaneous adipose tissue in the development of CVDs and their FRs is not fully defined. Therefore, full-fledged large-scale epidemiological studies are needed to determine the threshold values of obesity rates among different ethnic groups. It is also necessary to draw the attention of physicians and researchers of all specialities to the problem of underdiagnosis of obesity using ultrasound techniques.

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