ANATOMY

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Original Article

RELATIONSHIP OF QUANTITATIVE CHARACTERISTICS OF THE KIDNEYS WITH ANTHROPOMETRIC AND SOMATOTYPOLOGICAL PARAMETERS OF ADOLESCENT GIRLS IN THE DONETSK REGION

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ABSTRACT

The article presents updated data reflecting the quantitative characteristics of the kidneys in representatives of various somatotypes among adolescent girls in the Donetsk region. Given the high level of morbidity of the urinary system, regular review of echographic patterns of kidney normality is necessary. Determining the features of kidney size depending on the somatotype is an important task of morphology, corresponding to the modern trends of an individual approach in medicine. The information obtained is undoubtedly of value for ultrasound specialists, nephrologists, as well as scientists in theoretical medicine.

Materials and Methods: The object of the study was 150 polypositional ultrasound scans of the right and left kidneys of apparently healthy adolescent girls in the Donetsk region (75 subjects). The scans were obtained during a study in B-mode of the gray scale in standard positions (on the back and on the side) using the Radmir device, with a convex sensor. Anthropometric measurements were carried out according to the generally accepted V.V. Bunak's method. Somatotyping was performed according to the Sheldon's method as modified by Heath and Carter. Calculations were carried out in the Statistica 13 program.

Results: the subjects were divided into three groups, according to their specific somatotype. Morphometric ultrasound parameters of the right and left kidneys were obtained. During the statistical analysis, we established distinctive features of the morphometric parameters of the kidneys depending on the somatotypological affiliation of adolescent girls of the Donetsk region.

Conclusion: statistically significant differences were found in the quantitative characteristics of the right and left kidneys in representatives of different somatotypes.

Keywords: kidneys, anthropometry, somatotype, adolescence, female gender.

INTRODUCTION

The study of the kidneys structure is a relevant and important area of research in modern medicine, since they play a key role in maintaining homeostasis of the body and have a complex anatomical and functional structure [1]. The kidneys are located in the lumbar region of the abdominal cavity, on either side of the spinal column, with wide variations in their exact location even within the physiological norm [2].

Kidney function includes the elimination of toxic metabolites such as urea and creatinine, as well as the regulation of water-electrolyte balance and acid-base balance [3]. Various infectious processes, autoimmune inflammation, metabolic disorders and genetic abnormalities of the genitourinary system can cause disorders in these functions [4,5].

According to the World Health Organization, there is an increase in morbidity of the genitourinary system, which emphasizes the importance of early diagnosis and treatment of kidney diseases [6]. In this regard, research in the field of quantitative anatomy of the kidneys is of great interest for medical practice. Knowledge of the average size, structural features and variations of the anatomy of the kidneys is of critical value for the diagnosis and treatment of various diseases, as well as for planning surgical interventions, including kidney transplantation [7, 8].

Many researchers, both domestic and foreign, have devoted their work to the issues of quantitative anatomy of the kidneys [9]. Research in this area covers a wide range of methods, including morphometric analysis, the study of microscopic structure and the use of modern technologies such as three-dimensional modeling [10].

In addition, significant progress in the field of quantitative kidney anatomy has been achieved through the use of modern medical imaging techniques such as ultrasound, computed tomography, and magnetic resonance imaging. These methods provide high-quality three-dimensional images of the kidney structure and allow to perform accurate measurements of kidney size and volume [11].

Studying the structure of the kidneys in the context of body type is important for understanding the individual anatomical features of the organs and their functional activity [12]. Various components of the somatotype, such as endomorphic, mesomorphic and ectomorphic, can influence the anatomical location and size of the kidneys [13]. These individual differences may influence renal functional parameters such as filtration rate and excretory capacity [14]. Therefore, studying the structure of the kidneys in the context of body type allows us to better understand the mechanisms of body's adaptation to various physiological conditions and suggest individual characteristics of the reaction to various pathological processes [15].

Purpose of the study: to study the quantitative characteristics of the kidneys in relation to somatotypes in adolescent girls of the Donetsk region.

MATERIALS AND METHODS

The object of the study was 150 polypositional ultrasound scans of the kidneys of apparently healthy adolescent girls (75 subjects). The scans were obtained during a study in B-mode of the gray scale in standard positions (on the back and on the side) using the Radmir device, with a convex sensor. The following kidney dimensions were measured: length, width, longitudinal and cross section area, longitudinal section area of the sinus, length and width of the sinus, thickness of the parenchyma, thickness of the cortical and medulla layers of the right and left kidneys. Anthropometric measurements were carried out according to the generally accepted V.V. Bunak's method (1941) [16]. Somatotyping was carried out according to the Sheldon scheme as modified by Heath and Carter (2002) [17] based on the continuous distribution of three main components: endomorphy (fat component), mesomorphy (musculoskeletal component) and ectomorphy (describes body surface area and nervous system development). Calculations were carried out in the Statistica 13 program; the results were recorded in tables using Microsoft Office Excel 2019.

RESULTS

At the first stage, anthropometric measurements of the subjects were carried out according to the generally accepted V.V. Bunak's method. Based on the data obtained, somatotyping was carried out according to the Heath-Carter scheme, as a result of which the subjects were divided into three groups, according to their specific somatotype. The first group included persons of the endo-mesomorphic. There were 33 such girls, which accounted for 44% of the entire sample. The second group was formed by representatives of the endo-ectomorphic somatotype - 31 people (41%). The final group included girls of the ecto-mesomorphic somatotype - 11 subjects (15%). At the next stage, an ultrasound examination was performed, which allowed to obtain the linear dimensions of the right and left kidneys (Table).

Table. Indicators of quantitative kidney parameters in girls of different somatotypes

	Endo-mesomorphic somatotype		***Ecto-mesomorphic somatotype***		**Endo-ectomorphic *somatotype***	
Linear parameters of the kidneys	**left**	**right**	**left**	**right**	**left**	**right**
Length, cm	10,69±0,53*	10,59±0,56	10,29±0,38*	10,27±0,80	10,50±0,64	10,56±0,70
Width, cm	5,47±0,45	5,49±0,42	5,27±0,44	5,27±0,39	5,40±0,43	5,52±0,51
Longitudinal section area, cm^2	41,82±5,12#	37,42±5,59#	38,19±4,36#	34,88±5,47#	39,75±5,74	37,24±6,71
Cross section area, cm^2	24,06±4,38	23,13±4,16	25,54±3,29	22,56±4,67	25,27±3,65	23,37±4,74
Longitudinal section area of the sinus, cm^2	14,30±3,02	13,11±2,53	13,23±2,12	12,42±1,93	14,33±2,23#	11,88±2,84#
Sinus length, cm	7,07±0,59	6,97±0,66	6,90±0,53	6,87±0,38	7,03±0,63#	6,60±0,84#
Sinus width, cm	3,55±0,55	3,61±0,38*	3,53±0,66	3,31±0,19*	3,66±0,43	3,39±0,39*
Parenchyma thickness, cm	2,04±0,16	1,96±0,18	2,10±0,13	2,11±0,20	2,12±0,20#	2,01±0,21#
Cortical layer thickness, cm	1,04±0,16#	0,95±0,13*#	1,05±0,15	1,03±0,15	1,06±0,13	1,05±0,11*
Medulla thickness, cm	1,00±0,11	0,98±0,13	1,05±0,12	1,07±0,11*	1,05±0,14#	0,94±0,15*#

*Note: data format: m±sd; * - statistically significant differences in kidney parameters in individuals of different somatotypes; # - statistical differences in kidney parameters in individuals of the same somatotype;*

In the course of statistical analysis using the nonparametric Mann-Whitney test for independent samples, we found that only two studied parameters had statistically significant differences ($p<0.05$) in the quantitative characteristics of the kidneys on the right and left among representatives of the endo-mesomorphic somatotype. Thus, the longitudinal section area and thickness of the cortical layer of the left kidney were on average 9% greater than those of the right kidney ($p<0.05$).

Among girls of the ecto-mesomorphic somatotype, a statistically significant difference at the level of $p<0.05$ depending on whether the kidney was right or left was found in such a quantitative parameter as the cross section area of the kidney. According to this indicator, the left kidney (25.54±3.29 cm) exceeded the right one (22.56±4.67 cm) by an average of 12% ($p<0.05$).

Among adolescent girls of the endo-ectomorphic somatotype, the following quantitative parameters had a statistically significant difference at the level of $p<0.05$: the longitudinal section area of the sinus, the length of the sinus, the width of the sinus, the thickness of the parenchyma and the thickness of the medulla. The longitudinal section area of the sinus of the left kidney averaged 14.33±2.23 cm^2, exceeding this parameter of the right kidney (11.88±2.84 cm^2) by 17% ($p<0.05$). The length of the sinus of the left kidney (7.03±0.63 cm) was 6% greater than the length of the sinus of the right kidney (6.60±0.84 cm) ($p<0.05$). The width of the sinus of the left kidney (3.66±0.43 cm) also turned out to be greater than the width of the sinus of the

right kidney (3.39±0.39 cm) by 8% (p<0.05). The thickness of the left kidney parenchyma (2.12±0.20 cm) exceeded the right one (2.01±0.21 cm) by 5% (p<0.05). The thickness of the medulla of the left kidney (1.05±0.14 cm) exceeded the thickness of the medulla of the right kidney (0.94±0.15 cm) by an average of 11% (p<0.05).

To identify statistically significant differences in quantitative kidney parameters in individuals of different somatotypes, we used the Kruskal-Wallis test. The presented data had statistically significant differences at the p<0.05 level.

It can be reliably stated that, on average, the left kidney in representatives of the endo-mesomorphic somatotype (10.69±0.53 cm) was longer compared to girls of the ecto-mesomorphic somatotype (10.29±0.38 cm) by 4% (p<0.05).

The width of the sinus of the right kidney in persons of endo-mesomorphic body type (3.61±0.38 cm) was greater than this parameter in girls of ecto-mesomorphic somatotype (3.31±0.19 cm, p<0.05) and endo-ectomorphic somatotype (3.39±0.39 cm, p<0.05) by 9% and 6% respectively.

The thickness of the cortical layer of the right kidney in representatives of the endo-ectomorphic somatotype (0.94±0.15 cm) was on average 10% greater than in girls of the endo-mesomorphic body type (0.95±0.13 cm, p < 0.05).

At the same time, the thickness of the medulla of the right kidney of individuals of the ecto-mesomorphic somatotype (1.07±0.11 cm) was greater compared to students of the endo-ectomorphic somatotype (0.94±0.15 cm) on average by 12% (p<0.05).

CONCLUSIONS

Thus, it was established that in adolescent girls of the Donetsk region, 3 body types are most characteristic. An overwhelming number of those studied (44%) were classified as endo-mesomorphic somatotype, 41% of students had endo-ectomorphic somatotype, 15% of girls belonged to ecto-mesomorphic somatotype. It was revealed that the average size of the left kidney in the studied population generally exceeded the size of the right kidney (p<0.05). We found statistically significant differences in the quantitative indicators of the right and left kidneys in representatives of different somatotypes. Girls of the endo-mesomorphic body type had a greater length of the left kidney and the width of the sinus of the right kidney compared to representatives of the ecto-mesomorphic somatotype; as well as a greater width of the sinus compared to girls of the endo-ectomorphic somatotype. In girls of the ecto-mesomorphic (AOB) somatotype, the thickness of the medulla of the right kidney was greater than in students of the endo-ectomorphic somatotype, who, in turn, had higher values than girls of the endo-mesomorphic somatotype in terms of the thickness of the cortical layer of the right kidney.

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