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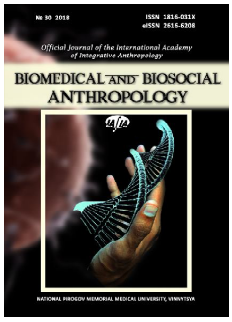

Somatotypological features of topographic kidney anatomy of patients without any kidney and urinary tract diseases

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The conducted analysis of modern literature shows that most of the established normative parameters of the placement of kidneys in healthy people have not been sufficiently studied, with researchers practically do not take into account the constitutional features of the organism. The purpose of the study was to determine the topographic anatomical position of the kidneys in the frontal, sagittal and horizontal planes on the basis of MRI in patients of different somatotypes without any kidney and urinary tract diseases. Complex examination of 65 patients of the first and second mature age of different somatotypes, which did not have kidney and urinary tract diseases, was performed. To determine the somatotype, we used the mathematical scheme for B.Heath and J.Carter (1990), with the definition of the endomorphic, mesomorphic and ectomorphic components of the somatotype. The renal topography was conducted on a Philips Intera-1.5T magnetic resonance imaging (standard magnetic resonance protocol included scanning in sagittal, frontal, and axial projections to obtain T1 weighted imaging). The angles of inclination were measured in the frontal, sagital and horizontal planes to measure spatial position of the kidneys. The statistical analysis of the obtained results was carried out using the "STATISTICA 5.5" program, using parametric and non-parametric methods for evaluating the obtained results. It was established that the angle of inclination of the kidney on the right side in the frontal and sagittal planes was greater in 1.23-1.41 times than in men and in women of representatives of all somatotypes. The angle between the axis and the line drawn through the middle of the vertebral bodies did not statistically significantly change, depending on the somatotype, sex and on the side of the study in a horizontal plane. The angles of inclination of the kidney axis are defined in three planes: the frontal, horizontal, and sagittal in the patients, with the kidney axis directed downwards outward and forward. Representatives of all somatotypes differed statistically significantly the angles of inclination of the left axis from the right kidneys in the frontal and sagittal planes.

Keywords: *kidneys, somatotypes, magnetic resonance imaging, position of the kidneys.*

Introduction

Determining of a kidney topography is important for diagnostic manipulations (kidney biopsy) and surgical interventions on kidneys, urinary tract and renal vessels [16]. The control of the size of kidneys and their comparison may be one of the main criterion for the detection of kidney damage. Increased kidney size is a major symptom of pyelonephritis and renal ischemia [17].

In the ultrasound scan of the kidney in the sagittal plane, a bright, even contour of elliptical shape can be clearly seen, when scanned in the frontal plane - a bean-shaped form, formed by an intense echo, reflected from its outer surface, corresponding to the fibrous capsule of the kidney [18]. However, the longitudinal kidney axis is not always perfectly reflected in an ultrasound study [8].

Scientists have established the dependence of the size of the kidney (height, width and thickness) on the body mass index [7]. The integral index, which correlates with body mass index and renal function, is the volume of the kidney [4]. Characteristically, the volume of kidneys from the inhabitants of the highlands was significantly lower than that of the inhabitants of the lowlands [22].

On the basis of mathematical models of linear sizes of both kidneys, a method is proposed for the determination of prognostic normal individual ultrasonic linear sizes of kidneys

of the inhabitants of the central region of Ukraine in adolescence [9].

The high diagnostic significance of magnetic resonance imaging (MRI) contributes to its widespread use in diagnosing most nephrology and urological diseases [2, 28]. The use of MRI in kidney disease requires a comparison with parameters of size and position of kidneys in practically healthy persons [5].

O.V. Novichechin and T.O. Kwiatkowska [23] conducted an MRI study of the kidneys of 32 healthy people, aged 27-70 years, and noted smaller dimensions of length, width, thickness, size and size of kidneys in the elderly compared with those in the first and second mature years.

As a result of the analysis of the interconnections of the sonographic sizes of the kidneys with the anthropometric and somatometric indices of healthy urban youth and girls of Podillia, various informative regimes of the standard individual sizes of the kidneys were constructed [10-14]. Dependence on somatotype of areas of longitudinal and transverse section of the kidneys and their sinuses in the almost healthy population of Podillia juvenile age was revealed [15]. The regression models of renal sonographic parameters are also presented, depending on the specific sizes of the body of healthy women in the mesomorphic somatotype [3]. Statistically significant differences in length, width and thickness of the kidneys were established, depending on the renal somatotype of the first and second mature patients who had no kidney and urinary tract diseases [21]. On the basis of the study of correlations of kidney parameters with weight, length, body surface area and age, it was concluded that the body structure (somatotype) is the main determinant for the mass of kidneys and the size of the renal glomeruli [24]. The degree of rotation of the kidney in subjects of various somatotypes to date not defined [27].

The conducted analysis of modern literature shows that most of the established normative parameters of the placement of kidneys in healthy people have not been sufficiently studied, with researchers practically do not take into account the constitutional features of the organism.

The purpose of the study was to determine the topographic anatomical position of the kidneys in the frontal, sagittal and horizontal planes on the basis of MRI in patients of different somatotypes without kidney and urinary tract diseases.

Materials and methods

The complex examination of 65 patients of the first and second mature age was carried out on the basis of Khmelnytsky regional and city hospitals, the medical center "Ultra Diagnostics", which gave voluntary written informational consent to the planning of clinical examination and treatment. Patients did not have kidney and urinary tract diseases or other chronic diseases that could cause complications from the organs of the urinary system.

The sample of patients was randomized, randomly selected patients without a defeat of the urinary system, which was computed-tomographic examination of the lumbar region.

Patients were diagnosed with non-alcoholic fatty liver disease, chronic pancreatitis, tumors of the stomach, diseases of the cardiovascular system.

Immediately before the study, all patients measured arterial pressure, pulse rate, clarified whether or not premeditated drugs have been taken affecting the renal blood circulation (antispasmodics, antihypertensive, sedative, etc.).

To determine the somatotype, we used a mathematical scheme for B.Heath and J.Carter (1990), with the definition of the endomorphic, mesomorphic and ectomorphic components of the somatotype, which measured the height (cm), body weight (kg), shoulder grip in the stressed state (cm), the coat of the leg (cm), the diameter of the distal epiphysis of the shoulder (cm), the diameter of the distal hip epiphysis (cm), and the thickness of the skin-fat folds under the shoulder on the back (mm), on the shoulder (mm), on the side (mm) on the legs (mm).

The renal topography was conducted on a Philips Intera-1.5T magnetic resonance imaging (standard magnetic resonance protocol included scanning in sagittal, frontal, and axial projections to obtain T1 weighted imaging). In the T2-weighted image, the contours of the kidney and renal sinus were not clear enough.

To measure spatial position of the kidneys, the angles of inclination were measured in the frontal, sagittal and horizontal planes. In the frontal plane, the angle between the median line taken through the middle of the vertebrae, and the axis of the kidney, carried through the poles (Fig. 1), was measured.

The angle between the axis of the kidney in the sagittal plane, was measured through the poles and the vertical

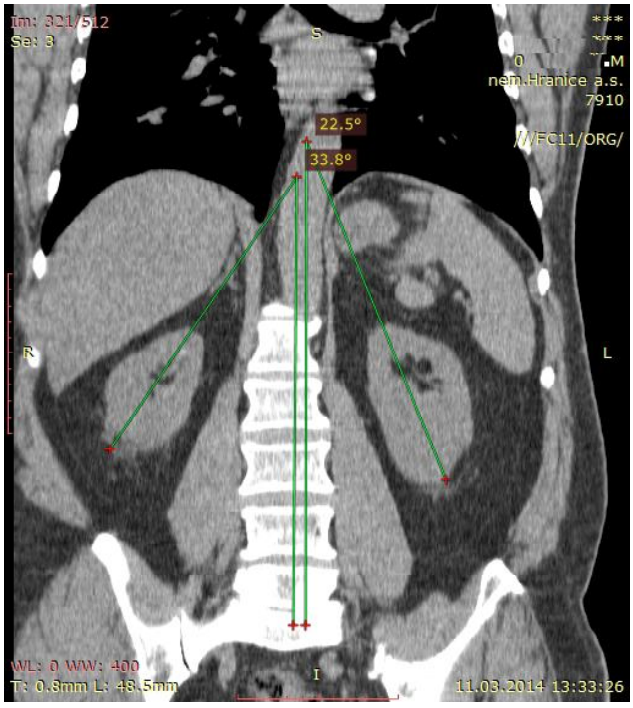

Fig. 1. Angles of the patient's left and right kidney inclination in the frontal projection of the kidney.

Fig. 2. The angle of inclination of the patient's left kidney in the sagittal projection of the kidney: the angle in the sagittal plane is 23.8o.

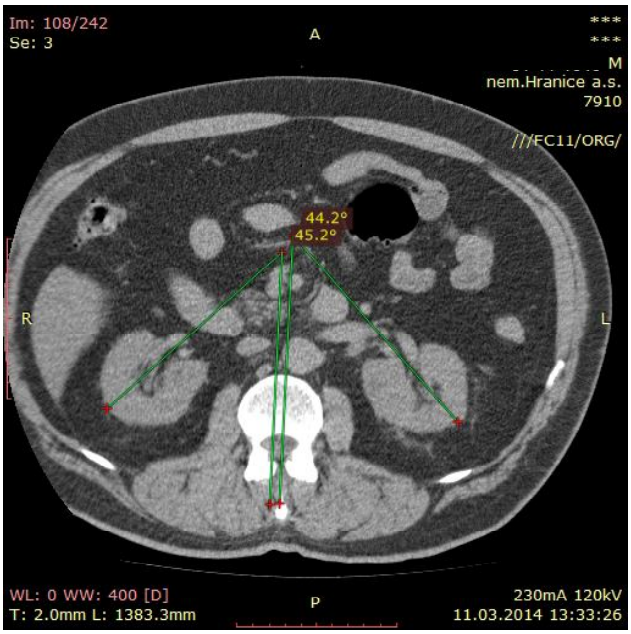

Fig. 3. The angles of inclination of the left and right kidneys of the patient K. in the horizontal projection of the kidney.

line (Fig. 2).

To evaluate the angle of rotation in the horizontal plane on the axial slice, the kidney axis was carried from the outer edge and through the middle of the kidney gate, respectively, determining the angle between the axis and the line drawn through the middle of the vertebral bodies (Fig. 3).

Statistical analysis of the obtained results was carried out using the STATISTICA 5.5 program from Statsoft license number AXXR910A374605FA) using parametric and non-parametric methods for estimating the obtained results.

Results

On the basis of the analysis of computer tomograms of patients of the first and second mature age who did not have diseases of the kidneys and urinary tract, the angles of placement of the axes of the kidneys in three coordinate planes, depending on the somatotype, were determined. Thus, in patients with ectomorphic somatotype, a statistically significant difference between the angle of inclination of the left kidney and the angle of the right kidney in the frontal and sagittal planes was found in both men and women (Table 1). The angle of the right kidney in the frontal plane was greater in 1.25-1.23 times, and in the sagittal plane at 1.25 - 1.24 times in men and women respectively. In a horizontal plane, the angle between the axis and the line drawn through the middle of the vertebral bodies did not statistically significantly change, depending on the gender and the side of the study.

In patients with mesomorphic somatotype, there was also a statistically significant difference between the angle of the left kidney compared with the angle of the right kidney in the frontal and sagittal planes in both men and women (Table 2). The angle of the right kidney in the frontal plane was greater in 1.32-1.31 times, and in the sagittal plane in 1.30-1.31 times in men and women respectively. In a horizontal plane, the angle between the axis and the line drawn through the middle of the vertebral bodies was not statistically significantly different from those of the ectomorphic and endomorphic somatotypes.

Patients with endomorphic somatotype as well as

Table 1. Parameters of the kidney topography of ectomorphic somatotype patients who did not have kidney and urinary tract diseases, according to MRI (M±σ).

Angle of the kidney (°)	Right kidney		Left kidney	
	Man (n=14)	Woman (n=20)	Man (n=14)	Woman (n=20)
In the frontal plane	28.6±2.8*	28.3±2.9*	22.8±2.5*	23.1±2.8*
In the sagittal plane	29.9±3.6*	30.1±3.4*	23.9±3.5*	24.2±2.6*
In the horizontal plane	43.4±5.1	43.5±5.2	44.2±5.2	44.8±4.5

Note: * - statistically significant differences ($p<0.05$) according to the Mana-Whitney criterion between the respective indices in comparison with the indicators of the inclining angle of the kidney from the opposite side.

Table 2. Parameters of the kidney topography of mesomorphic somatotype patients who did not have kidney and urinary tract diseases, according to MRI (M±σ).

Angle of the kidney (°)	Right kidney		Left kidney	
	Man (n=9)	Woman (n=11)	Man (n=9)	Woman (n=11)
In the frontal plane	31.6±3.9*	30.8±3.8*	23.8±3.4*	23.5±3.8*
In the sagittal plane	31.5±3.8*	32.2±3.6*	24.1±3.8*	24.5±3.3*
In the horizontal plane	44.9±4.5	45.1±4.8	45.2±5.7	45.1±4.0

Note: * - statistically significant differences ($p<0.05$) according to the Mana-Whitney criterion between the respective indices in comparison with the indicators of the inclining angle of the kidney from the opposite side.

Table 3. Parameters of the kidney topography of endomorphic somatotype patients without any kidney and urinary tract diseases, according to MRI (M±σ).

Angle of the kidney (°)	Right kidney		Left kidney	
	Man (n=4)	Woman (n=7)	Man (n=4)	Woman (n=7)
In the frontal plane	34.6±4.2*	33.5±3.8*	24.6±4.0*	24.2±4.0*
In the sagittal plane	31.8±3.3*	32.9±3.5*	25.3±3.5*	25.8±3.8*
In the horizontal plane	45.8±3.8	45.9±3.7	45.5±5.6	45.7±3.5

Note: * - statistically significant differences ($p<0.05$) according to the Mana-Whitney criterion between the respective indices in comparison with the indicators of the inclining angle of the kidney from the opposite side.

representatives of ectomorphic and mesomorphic somatotypes showed a statistically significant difference between the angle of the left kidney compared with the angle of the right kidney in the frontal and sagittal planes in both men and women (Table 3). The angle of the right kidney in the frontal plane was greater in 1.41-1.38 times, and in the sagittal plane at 1.25-1.28 times in men and women, respectively. The angle between the axis and the line drawn through the middle of the vertebral bodies was not statistically significantly different from those of the ectomorphic and mesomorphic somatotypes in the horizontal plane.

Discussion

A significant number of publications in current literature deal with issues of sexual and age-related changes in kidney size, most of which were obtained in the study of autopsy material of practically healthy people [6]. It is known that the kidney is characterized by a pronounced individual variability [1]. The authors prove the existence of interrelationships between the size, volume of the kidney and the component composition of the human body in adulthood. Statistically significant biliary differences in the size characteristics of the kidneys are established: the size of the right kidney predominates over the size of the left [25].

Our studies of the morphometry of the corners of the kidneys in three planes confirm the conclusion of the life-time study of patients S.M. Lyaschenko [20] states that there are no statistically significant differences in the spatial position of the kidneys in the age and sex. However, we found that in the frontal and sagittal planes, the angles of inclination of the left and right kidneys in the representatives of all somatotypes were statistically significantly different. The greater values of the angles of the right kidney are explained by the pressure of the right lobe of the liver on the upper pole of the right kidney [19].

Investigations of the relationship of the topographic anatomical position of the kidney with the types of human constitution are of interest to clinicians. The prolapse of the kidney in conjunction with pathological rotation due to topographic anatomical features is accompanied by hemodynamic disorders [26] and the development of urolithiasis.

Investigating the angles of the kidney in the frontal, sagital and horizontal planes will complement the diagnosis and determine the pathogenesis of pathological processes occurring in the kidney due to the change in position, and provide correct treatment.

In the future, it is planned to investigate the degree of kidney confusion in patients of various somatotypes with respect to the line held in the frontal plane through the anterior surface of the lumbar vertebrae.

Conclusions

1. The angles of inclination of the kidney axis are defined in three planes: the frontal, horizontal, and sagittal in the patients, with the kidney axis directed downwards outward and forward.

2. Representatives of all somatotypes differed statistically significantly the angles of inclination of the left axis from the right kidneys in the frontal and sagittal planes.

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Монастирський В. М., Півторак В. І.

СОМАТОТИПОЛОГІЧНІ ОСОБЛИВОСТІ ТОПОГРАФІЧНОЇ АНАТОМІЇ НИРКИ ПАЦІЄНТІВ, ЯКІ НЕ МАЛИ ЗАХВОРЮВАНЬ НИРОК ТА СЕЧОВИХ ШЛЯХІВ

Проведений аналіз сучасної літератури свідчить, що більшість встановлених нормативних параметрів розміщення нирок у здорових людей вивчені недостатньо, при цьому дослідники практично не враховують конституціональні особливості організму. Мета дослідження - на основі МРТ визначити топографоанатомічне положення нирки у фронтальній, сагітальній та горизонтальній площинах у пацієнтів різних соматотипів, які не мали захворювань нирок та сечових шляхів. Проведено комплексне обстеження 65 пацієнтів першого та другого зрілого віку різних соматотипів, які не мали захворювань нирок та сечових шляхів. Для визначення соматотипу ми застосовували математичну схему за B.Heath і J.Carter (1990), з визначенням ендоморфного, мезоморфного й ектоморфного компонентів соматотипу. Дослідження топографії нирки проводили на магнітно-резонансному-томографі Philips Intera-1,5T (стандартний протокол магнітного резонансу включав в себе сканування в сагітальній, фронтальній та аксіальній проекціях з отриманням Т1 зважених зображень). Для характеристики просторового положення нирок у фронтальній, сагітальній і горизонтальній площинах були виміряні кути нахилу. Статистичний аналіз отриманих результатів проведена з застосуванням програми "STATISTICA 5.5" з використанням параметричних і непараметричних методів оцінки отриманих результатів. Встановлено, що кут нахилу нирки з правого боку у фронтальній та сагітальній площинах був більший у 1,23-1,41 рази як у чоловіків, так і у жінок представників усіх соматотипів. У горизонтальній

площині кут між віссю і лінією, проведеною через середину тіл хребців статистично значуще не змінювався в залежності від соматотипу, статі та від сторони дослідження. Визначені кути нахилу осі нирки у трьох площинах: фронтальній, горизонтальній та сагітальній у пацієнтів, при цьому вісь нирки спрямована вниз назовні і вперед. У представників усіх соматотипів статистично значуще відрізнялися кути нахилу осей лівої від правої нирок у фронтальній і сагітальній площинах.
Ключові слова: *нирки, соматотипи, магнітно-резонансна томографія, положення нирок.*

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СОМАТОТИПОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ТОПОГРАФИЧЕСКОЙ АНАТОМИИ ПОЧКИ ПАЦИЕНТОВ, НЕ ИМЕВШИХ ЗАБОЛЕВАНИЙ ПОЧЕК И МОЧЕВЫХ ПУТЕЙ

Проведенный анализ современной литературы свидетельствует, что большинство установленных нормативных параметров размещения почек у здоровых людей изучены недостаточно, при этом исследователи практически не учитывали конституциональные особенности организма. Цель исследования - на основе МРТ определить топографоанатомическом положения почки в фронтальной, сагиттальной и горизонтальной плоскостях у пациентов различных соматотипов, которые не имели заболеваний почек и мочевых путей. Проведено комплексное обследование 65 пациентов первого и второго зрелого возраста различных соматотипов, которые не имели заболеваний почек и мочевых путей. Для определения соматотипа мы применяли математическую схему с B.Heath и J.Carter (1990), с определением эндоморфного, мезоморфного и эктоморфного компонентов соматотипа. Исследование топографии почки проводили на магнитно-резонансном томографе Philips Intera-1,5T (стандартный протокол магнитного резонанса включал в себя сканирование в сагиттальной, фронтальной и аксиальной проекциях с получением Т1 взвешенных изображений). Для характеристики пространственного положения почек во фронтальной, сагиттальной и горизонтальной плоскостях были измерены углы наклона. Статистический анализ полученных результатов проведен с применением программы "STATISTICA 5.5" с использованием параметрических и непараметрических методов оценки полученных результатов. Установлено, что угол наклона почки с правой стороны в передней и сагиттальной плоскостях был больше в 1,23-1,41 раза как у мужчин, так и у женщин представителей всех соматотипов. В горизонтальной плоскости угол между осью и линией, проведенной через середину тел позвонков, статистически значимо не изменялся в зависимости от соматотипа, пола и от стороны исследования. Определены углы наклона оси почки в трех плоскостях: фронтальной, горизонтальной и сагиттальной у пациентов, при этом ось почки направлена вниз наружу и вперед. У представителей всех соматотипов статистически значимое отличались углы наклона осей левой от правой почек во фронтальной и сагиттальной плоскостях.
Ключевые слова: *почки, соматотипы, магнитно-резонансная томография, положение почек.*