

KIDNEY ULTRASOUND PARAMETERS AND RENAL BLOOD BIOCHEMISTRY MARKERS IN POST-HEMORRHAGIC STROKE HYPERTENSIVE SURVIVORS

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Summary

Introduction. Hemorrhagic stroke is a serious and devastating complication of arterial hypertension, which leads to increased mortality in survivors even after the early recovery period. Being other target organs for arterial hypertension, kidneys take part in blood pressure regulation. Investigation of their peculiarities in such patients may provide valuable data on possible reasons of poor long-term prognosis in this category of patients.

The aim of the study: to compare kidney ultrasound parameters and renal blood biochemistry tests between the post-hemorrhagic stroke hypertensive subjects in a stable phase of recovery period and the patients with arterial hypertension who had no cerebrovascular and cardiovascular events.

Materials and methods. There were 100 subjects enrolled into the study. They formed two investigatory groups: the main (n=64; age – 52,2±8,41 years, M±SD years) and the control (n=36; age – 51,8±5,92 years) one. Hypertensive patients of the main group developed hemorrhagic stroke – subarachnoid hemorrhage (SAH) (n=42) or intracerebral hemorrhage (ICH) (n=22) – ≥6 months prior to the examination conducted at this study. The control group consisted of patients with non-complicated arterial hypertension. In both groups of patients, the kidney ultrasound parameters and blood plasma urea, creatinine and uric acid concentration levels were determined. Estimated glomerular filtration rate (eGFR) was calculated.

Results. The indices of kidney ultrasound parameters in the main group and the control group were the following ones, respectively: the pole-to-pole size of the right kidney was 9,96±1,05 and 11,63±1,26 cm, the same size of the left kidney – 10,39±0,93 and 11,95±1,23 cm, p<0,01 for both pairs. Among the biochemistry blood plasma indices, uric acid concentration reached significant difference as well – 411,21±60,36 and 360,91±75,3 μmol/L in the relevant groups, respectively (p=0,04). On the other hand, eGFR did not show the difference between the study groups. The main group was characterized by a higher prevalence of kidney stone formation – OR 5,00 (95 % CI, 1,83-13,65). The statistically significant higher incidence rate of calculus development was identified in two subgroups of the main group as well: for SAH – OR 3,08 (95 % CI, 1,05-9,02), for ICH – OR 13,33 (95 % CI, 3,69-48,15). When comparing to the control group, kidney cyst identification rate in the SAH subgroup referred to OR 3,08 (95 % CI, 1,05-9,02), while kidney pelvis/calices enlargement incidence rate was higher in the ICH subgroup OR 9,17 (95 % CI, 2,15-39,06).

Conclusions. The obtained data indicate the smaller pole-to-pole dimension of both kidneys in hypertensive subjects who suffered hemorrhagic stroke, accompanying higher incidence rate of kidney calculus formation in view of the increased blood plasma uric acid concentration. The same is typical for the SAH individuals subgroup but with the addition of prevalence of kidney cysts incidence rate. As for the ICH subgroup, in addition to the main group findings, pelvis/calices enlargement is observed more frequently when comparing to the hypertensive only subjects.

Key words: intracerebral hemorrhage, subarachnoid hemorrhage, hypertension, kidney stone disease, renal cyst

INTRODUCTION

The autoregulation of cerebral blood flow leads to active changes in vascular resistance to maintain a constant level of blood pressure (BP) in a relatively wide range of its fluctuations in general blood circulation [2]. In case of hemorrhagic stroke (HS), the cerebral circulation autoregulation is impaired [9, 11]. The kidneys, like the brain, are recipients of a large percentage of cardiac output, and are ones of the most sensitive organs, requiring tight conditions to maintain optimal function. Like the cerebral vascular circuit, the renal one is a low-pressure circulation and depends on autoregulation [4]. To summarize the above-mentioned, hypertensive subjects with prior HS may be at a higher risk of kidneys damage in view of the other organ with autoregulation (brain) did not cope with the blood pressure overload that caused the rupture of the arterial wall.

It is worth mentioning that approximately half of patients with intracerebral hemorrhage (ICH) have the lethal outcome within the first year after the event took place that requires improvement of the clinical strategy [18]. ICH patients with greater baseline blood plasma creatinine level were identified to be at higher risk for acute kidney injury (AKI) and renal adverse events development [15]. AKI immediately after ICH is a serious medical complication and an independent predictor of short-term mortality [19] that requires a follow-up investigation of kidneys among HS survivors.

Another reason to study kidneys in such patients belongs to the association between renal cysts and subarachnoid hemorrhage (SAH). For example, in case of the presence of autosomal dominant polycystic kidney disease (ADPKD), by the age of 65 years, 45-70 % of individuals develop end-stage renal disease. According to the investigation, 68,4 % of them suffer from hypertension and 3,8 % have cerebral artery aneurysm [14].

Kidney stone disease (KSD) is the potential comorbidity in post-HS hypertensive patients as well. The prevalence rate of KSD in European countries is 5-9 %, among which the leading positions belong to the countries of Eastern Europe [10]. As for nephrolithiasis association, the results of multivariate-adjusted analysis within the 9 hypertensive study populations showed the odds ratio (OR) range of 1,24-1,96 with an overall multivariate-adjusted OR of 1,43 (95 % confidence interval (CI), 1,30-1,56). The authors of the study have found a significant heterogeneity ($I^2 = 83,5$ %, $p < 0,001$) but they could conclude that nephrolithiasis was associated with a higher risk of hypertension [17]. Moreover, the risk of stone formation is higher among subjects with ADPKD in comparison to the general population [16].

Hence, it is reasonable to investigate the peculiarities of kidney ultrasound parameters and biochemistry blood tests in post-HS hypertensive survivors to summarize the data, which

refer specifically to the cohort of people with long-lasting arterial hypertension with the indicated severe complication.

THE AIM: to compare kidney ultrasound parameters and renal blood biochemistry tests between the post-hemorrhagic stroke hypertensive subjects in a stable phase of recovery period and the patients with arterial hypertension who had no cerebrovascular and cardiovascular events.

MATERIALS AND METHODS

According to the design, there was a case control study with the involvement of 100 subjects, who formed two groups. The main group covered 64 patients at least 6 months after HS incidence caused by arterial hypertension. The HS incidence management was performed at the clinic of vascular neurosurgery of the State Institution «Romodanov Neurosurgery Institute of the National Academy of Medical Sciences of Ukraine».

To focus on the hypertension impact factor in HS development, the following exclusion criteria were met: congenital diseases of connective tissue, prior radiotherapy or chemotherapy, vasculitis, embolic (bacterial, mycotic, oncogenic) HS, hemorrhagic transformation of the ischemic stroke, HS of iatrogenic or dysembryogenetic origin, Marfan's syndrome, fibromuscular dysplasia, α 1-antitrypsin deficiency, pregnancy, drug abuse, SAH as a result of rupture of an arteriovenous malformation or angioma, dissected or fusiform aneurysm, open circle of Willis (aplasia of at least one of its arteries), medical history of moderate and severe head trauma, tumors of the central nervous system, prior hypertensive cardiovascular events. In view of the pathoanatomical classification of bleeding into haemorrhagia per rhexin, haemorrhagia per diabrosin, haemorrhagia per diapedesin, according to the neuroimaging data only individuals with haemorrhagia per rhexin were selected for the study.

Those individuals, who recovered neurologically up to 50-100 points according to the Barthel scale and had BP $\geq 140/90$ mm Hg after the indicated cerebrovascular event, were asked for enrollment into the study. The 6-months cut-off period after HS incidence was chosen to have the patients in the stable phase. Mean recovering period was $17,8 \pm 11,67$ months (from 6 to 51 months). The control group was formed of the hypertensive patients naïve to cerebrovascular and cardiovascular events ($n=36$). The characteristics of the study groups are shown in Table 1. The groups were matched by age, sex, height, body mass index; all the patients were of Caucasian origin. These parameters were chosen in view of their influence on kidney sizes, especially height [6].

In view of the main group consisted of patients of different site origin of bleeding – arterial aneurysm (SAH) and artery rupture (ICH) – these two cohorts of patients were also analyzed. These two subgroups were matched by the above-mentioned key indicators as well.

Table 1

Characteristics of patients of the studied groups (M±SD)

Index	Main group, n=64	Control group, n=36	p value (main group vs control group)	SAH subgroup, n=42	ICH subgroup, n=22	p (SAH subgroup vs ICH subgroup)
Middle age, years	52,2±8,41	51,8±5,92	0,76	51,4±9,20	53,8±6,87	0,08
Quantity of men, n	30 (46,8 %)	17 (47,2 %)	-	18 (42,9 %)	12 (54,5 %)	-
Height, cm	167,8±7,88	169,1±6,96	0,81	168,9±8,35	165,9±6,98	0,14
Body mass index, kg/m ²	28,79±4,33	28,91±4,27	0,91	28,21±4,02	29,78±4,86	0,22
Office systolic BP, mm Hg	158,1±16,25	156,2±14,48	0,79	157,3±16,05	159,8±17,16	0,56
Office diastolic BP, mm Hg	98,3±7,34	97,9±8,02	0,75	98,2±7,21	98,7±7,60	0,81

The examination of all patients was done at the clinical sites of the Department of propaedeutics of internal medicine № 1 of the Bogomolets National Medical University within the period Nov-2016 – Jul-2018.

An ultrasound examination of the kidneys was performed on an ultrasound machine «Vivid-7 Pro» device (General Electric, USA). The pole-to-pole size, width of the organ and renal parenchymal thickness were measured. The macrostructure of kidneys, renal pelvis/calices were evaluated and the stones, cysts, lipomas were measured if they were detected. If there were few cysts/stones/lipomas at one patient, the biggest one in diameter was taken into analysis. Additionally, the standard renal fasting blood panel indices of serum creatinine, urea and uric acid were determined according to the standard methodics. A Cockcroft-Gault equation was utilized for estimated glomerular filtration rate (eGFR) calculation:

$$eGFR = \frac{(140 - \text{age}) \times \text{weight} \times \text{constant}}{\text{serum creatinine}},$$

where: *constant* equals 1,23 for males and 1,04 – for females.

The IBM SPSS Statistics Base v.22 (Chicago, IL, USA) software was utilized to perform statistical processing of the data [8] (license agreement of the Bogomolets National Medical University with the registration № 138 dated 04.08.2016).

The arithmetic mean of the sample (M), standard deviation (SD), level of statistical significance reached (p) were used to describe the distribution of demographic and clinical parameters. A Shapiro-Wilk analysis was used to determine normality of variables distribution. The difference between the compared parameters of the investigation groups was evaluated by Student’s t-test in case of normal distribution of the variants and by the U-test of Mann-Whitney when abnormal distribution of the variants was present. The analysis of

the obtained results was performed following the generally accepted recommendations [1]. The difference between the investigatory groups was assessed as statistically significant when p<0,05. The dominance of prevalence of the identified kidney abnormalities in a specific group/subgroup was evaluated using odds ratios (ORs) and 95 % confidence intervals (CIs).

The study was performed according to Helsinki Declaration of the World Medical Association «Ethical Principles of Medical Research with Human Participation» (1964, updated in 2000). The patient or his legal representative dated and signed the Informed Consent Form (Expert opinion of the Ethics Commission of the Bogomolets National Medical University dated 26-Oct-2016, protocol № 98).

RESULTS

According to the obtained indices of kidney ultrasound examination, the pole-to-pole sizes of both organs were significantly smaller in the main group in comparison to the control one – the arithmetic mean value was 14,4 % smaller for the right kidney and 13,1 % – for the left one (Table 2). Nevertheless, the width sizes did not show the difference between two groups of patients. As well as width size, the renal parenchymal thickness did not reach statistically significant difference; however, the left kidney showed a trend of renal parenchymal thickness to be slightly bigger in the control group.

As for the renal stone diameter, the mean value was 53,3 % bigger in the main group in comparison to the control one, but no statistical significance was reached between them in view of big SD value. Despite blood plasma creatinine level was revealed statistically significant smaller in the main group versus the control one, when assessing eGFR, no difference was observed. The greater variability of this index at the HS-survivors may signify the predisposition of some subjects to progressive kidney damage, who should be identified as soon as possible.

Table 2

Kidney ultrasound and biochemistry parameters (M±SD)

Index	Main group, n=64	Control group, n=36	p (main group vs control group)	SAH subgroup, n=42	ICH subgroup, n=22	p (SAH subgroup vs ICH subgroup)
Right kidney pole-to-pole size, cm	9,96±1,05	11,63±1,26	<0,01	9,95±1,06	9,98±1,07	0,60
Right kidney width, cm	5,17±0,80	5,1±0,83	0,65	5,1±0,80	5,31±0,83	0,48
Right renal parenchymal thickness, cm	1,65±0,27	1,60±0,31	0,53	1,62±0,30	1,71±0,23	0,35
Left kidney pole-to-pole size, cm	10,39±0,93	11,95±1,23	<0,01	10,49±1,01	10,19±0,78	0,39
Left kidney width, cm	5,64±0,75	5,83±0,67	0,72	5,71±0,78	5,51±0,72	0,70
Left renal parenchymal thickness, cm	1,77±0,27	1,85±0,31	0,07	1,75±0,29	1,8±0,24	0,42
Kidney stone diameter, cm	0,46±0,22	0,30±0,17	0,16	0,47±0,25	0,45±0,21	0,63
Kidney cyst diameter, cm	1,90±0,89	1,95±0,64	0,87	1,97±1,00	1,4±0,26	0,50
Blood plasma creatinine, μmol/L	72,59±10,89	84,31±12,24	0,05	70,6±15,23	73,43±13,61	0,86
eGFR, mL/min/1,73m ²	123,97±63,85	96,94±16,49	0,30	130,69±80,47	110,52±20,4	0,82
Blood plasma urea, mmol/L	5,90±1,96	5,41±1,46	0,16	6,05±3,22	6,18±1,02	0,55
Blood plasma uric acid, μmol/L	411,21±60,36	360,91±75,3	0,04	406,36±62,27	423,33±62,28	0,74

To analyze the peculiarities of HS subtypes, the results of the main group were assessed separately for arterial aneurysm and artery rupture. If to compare the subgroups of the main group, none index hit the statistically significant level of difference. However, the mean value of renal cyst diameter was 40,7 % bigger among the post-SAH subjects in comparison to the post-ICH individuals that was anticipated in view of the association of aneurysm appearance in those ones with ADPKD.

The next step of the study was to determine the peculiarities of incidence rate of kidneys abnormalities.

As presented in Table 3, pelvis/calyces enlargement and kidney calculus were observed more commonly among the patients who experienced HS. Nearly the same could be told about the renal cyst dominance among the main group individuals but no statistical significance was found. OR between the two groups for kidney pelvis/calyces enlargement was 4,30 (95 % CI, 1,17-15,82), for kidney stone identification – 5,00 (95 % CI, 1,83-13,65), for kidney «sand» finding – 1,11 (95 % CI, 0,46-2,68), for kidney cyst identification – 2,62 (95 % CI, 0,95-7,24) and for kidney lipoma finding – 2,97 (95 % CI, 0,33-26,43).

Table 3

Incidence rate of kidneys abnormalities

Index	Main group, n=64	Control group, n=36	SAH subgroup, n=42	ICH subgroup, n=22
Renal pelvis/calyces enlargement, n	18 (28,1 %)	3 (8,3 %)	8 (19,0 %)	10 (45,5 %)
Kidney stone, n	32 (50,0 %)	6 (16,7 %)	16 (38,1 %)	16 (72,7 %)
Kidney «sand», n	21 (32,8 %)	11 (30,6 %)	12 (28,6 %)	9 (40,9 %)
Kidney cyst, n	22 (34,4 %)	6 (16,7 %)	16 (38,1 %)	6 (27,3 %)
Kidney lipoma, n	5 (7,8 %)	1 (2,8 %)	4 (9,5 %)	1 (4,5 %)

Kidney cysts were more frequently diagnosed in post-aneurysmal rupture patients resulted in SAH. On the other hand, renal pelvis/calyces enlargement, kidney stone and kidney «sand» were more frequently observed among the hypertensive patients who experienced artery rupture – post-ICH subgroup.

Finally, the incidence rate of kidney abnormality identification was assessed between each subgroup of the main group and the control one. The results are provided at the Figure 1.

Summarizing the received results, it can be concluded that kidney stone presence and kidney pelvis/calyces enlargement are more typical at post-ICH subjects. As for the post-SAH individuals, the prevalence of kidney stone and cysts is more pronounced. The provided results give the hint on the necessity to require obligatory kidney ultrasound examination with the relevant blood plasma biochemistry markers assessment (kidney tests panel) at the long-term follow up of such subgroups of patients with the appropriate treatment assignment.

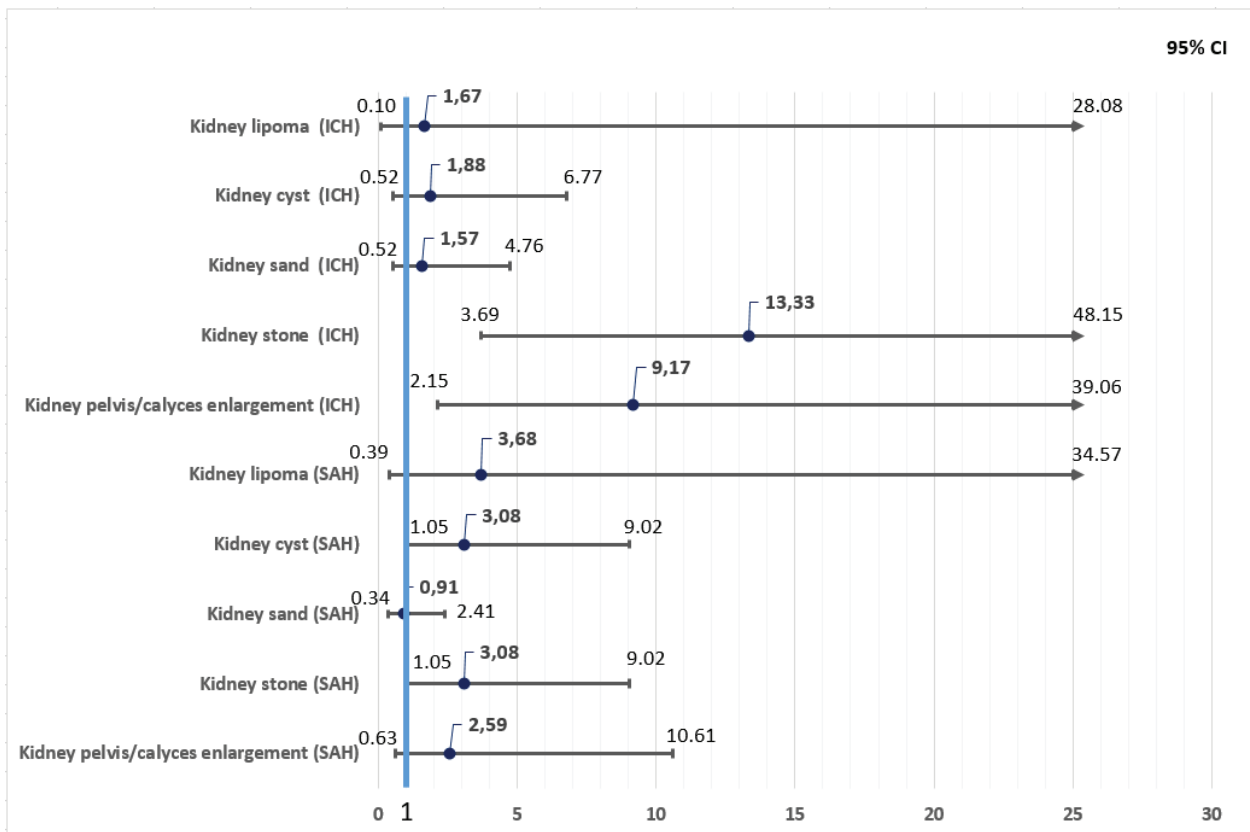


Fig. 1. OR for higher incidence rate of kidneys abnormalities between study SAH/ICH subgroups and control group

Note: the abbreviation in parenthesis signifies the subgroup, which was compared with the control group.

DISCUSSION

The main idea of this study was to draw attention to the presence of long-lasting arterial hypertension in all of the subjects, which was the main factor to cause the primary complication in the form of HS. It was the starting point for assessment of comorbidities from the kidneys perspective after the HS occurrence. We have not found such an approach in other investigations, as preferably, the patients are investigated from the neurosurgical perspective focusing attention on ICH or SAH without addressing to hypertensive only subjects. On the other end, nephrologists predominantly evaluate the kidney diseases without paying specific attention to the subtypes of stroke history. Hence, in our study we tried to have a look at the whole picture from the point of view of arterial hypertension comorbidities utilizing numerous exclusion criteria.

In view of the obtained results, the smaller longitudinal sizes of kidneys in patients of the main group compared with the control one may indicate a severer course of hypertension with the progressive changes in the organ’s parenchyma that led to its diminishment. Nevertheless, the results of the eGFR and parenchyma thickness (no significant difference between two groups) do not confirm this assumption. However, it should be

considered that we examined survived subjects after ≥ 6 months after HS, and those ones only with the acceptable level of recovery. Possibly, the cause of statistically non-significant difference in eGFR between two groups was due to the long-term survival status and better recovery results of our patients in comparison to the other subjects, as it is determined that the decreased eGFR is associated with unfavorable outcomes following hemorrhagic stroke (ICH) [3].

There was an interesting study on long-term follow up of the patients, which may provide us with the valuable insight. Its goal was to evaluate the relationship between AKI following ICH and long-term mortality in a 10-year retrospective cohort. AKI was revealed to be a long-term independent predictor of mortality in ICH patients. Thus, the authors highlight the need of renal function routinely examination after the ICH incidence [19]. Occurrence of AKI was associated with higher rates of death and disability at 3 months after the HS [15]. These results support our above-mentioned assumption: some patients could die and the others did not recover up to the appropriate 50 points according to the Barthel scale to have the possibility to attend our clinical site.

It is known that pole-to-pole length of an adult human kidney is 10-13 cm, and the left one is slightly longer than the right one [6]. Hence, the other potential discussion may occur around the subjects whose smaller pole-to-pole size could possibly be associated with the course of hypertension leading to HS development due to inappropriate BP regulation, possibly caused by this organ smaller pole-to-pole size that requires further investigations.

Another item, which needs to be discussed, refers to the incidence rate of renal cysts. The results of one of the ADPKD studies show that arterial hypertension had been identified before aneurysmal SAH in 69 % of the ADPKD patients versus 27 % of controls ($p < 0,001$); multiple intracranial aneurysms were present in 44 % of subjects in the ADPKD group versus 25 % in the non-ADPKD aneurysmal SAH patients ($p = 0,03$) [13]. There was another study with the focus on ADPKD patients, who experienced nephrolithiasis in 38,92 % and hypertension in 50,30 % [12]. Despite the design of the study was a bit different, these results supports our findings that permitted us to identify a higher prevalence of kidney stones formation among the subjects in the main group. Some investigators concluded that hypertension increases the risk of KSD, but KSD didn't affect the outcome of hypertension [20].

A large analysis of 10,521 adults showed the prevalence of kidney stones was 11,0 % (95 % CI 10,1-12,0) in general population. The 12-month incidence of kidney stones was 2,1 % (95 % CI 1,5-2,7), or 2,054 stones per 100,000 adults. The authors inform on significant relationship between stone incidence and subject age, body mass index, race and history of hypertension [5]. In our study we received 16,7 % of incidence among hypertensive complication-naïve subjects, which is slightly higher than the above-mentioned data that supports the statements in the previous paragraph.

The Iranian study which had a comparable group of the patients by age $49,94 \pm 9,56$ years, among which 24,1 % of the population had kidney stones. After adjustment of the variables, six of them – gender, wealth score index, no consumption of purified water, body mass index, and history of hypertension and diabetes – were identified to be statistically significant related characteristics of KSD development [7]. In view of the importance of ethnicity and water quality, these results are very high in the relevant region. Nevertheless, our patients from the main group showed much higher incidence rate – 50 %, especially due to the ICH subgroup.

The smaller longitudinal size of the kidneys together with the predisposition to cysts and higher incidence rate of pelvis/calices enlargement with the prevalence of nephrolithiasis may indicate the bigger risk of abnormal

blood pressure autoregulation. On the other hand, the AKI at the HS incidence possibly could lead to diminishment of the longitudinal size of kidney. The third option could be the concomitant damage due to blood pressure fluctuations with the high susceptibility of cerebral and nephrotic arteries, both of which suffer most from BP dysregulation issue.

According to the data obtained at our study and taking into account the results of the previous studies, it may be concluded that hypertensive subjects after HS are more prone to comorbidity in KSD and kidney cysts. Potentially, it may increase autonomic dysregulation of the cardiovascular system in view of higher uric acid concentration and some cysts with the tendency to grow, which might contribute to the higher risks of subsequent cerebrovascular events.

There are few weak points of this study, which should be reflected. First of all, we did not provide magnetic resonance imaging/computer tomography scans of kidneys which are considered to be more precise methods for the assessment of kidneys parameters. Moreover, cysts parameters could not be assessed according to Bosniak classification in view of the investigation without contrast enhancement. Secondly, the sample of ICH patients was not so big to rule out firm conclusions. Thirdly, we did not conduct the genetic testing of patients, including, for example for ADPKD.

CONCLUSIONS

1. Post-HS hypertensive survivors ≥ 6 months after the cerebrovascular incidence possess smaller both pole-to-pole kidney sizes in comparison to the hypertensive patients without complications: right kidney – $9,96 \pm 1,05$ cm, left kidney – $10,39 \pm 0,93$ cm, respectively.
2. Kidney cysts occur more frequently among SAH subgroup of hypertensive patients in comparison to individuals with non-complicated hypertension – OR 3,08 (95 % CI, 1,05-9,02).
3. Patients in the main group have higher frequency of kidney stone incidence in comparison to the control one – OR 5,00 (95 % CI, 1,83-13,65), which is raising to much more pronounced difference in the ICH subgroup when comparing to HS-naïve patients – OR 13,33 (95 % CI, 3,69-48,15). Uric acid concentration in blood plasma of post-HS subjects was $411,21 \pm 60,36$ $\mu\text{mol/L}$ that was 13,9 % higher according to the mean value in comparison to the control one ($p = 0,04$).
4. Kidney pelvis/calices enlargement happens most frequently in post-ICH patients when comparing to the patients with hypertension – OR 9,17 (95 % CI, 2,15-39,06).
5. Blood plasma creatinine level was revealed statistically significant smaller in the main group

(72,59±10,89 μmol/L) versus the control one. However, when assessing eGFR no difference was observed, mainly due to the greater variability of this index at the HS-survivors.

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CONTRIBUTION OF THE AUTHORS TO THE PREPARATION OF THE ARTICLE

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Tkachyshyn O. V. – clinical data collection, statistical data processing, writing

Tkachyshyna N. Yu. – clinical data collection

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*Резюме***ПАРАМЕТРИ УЛЬТРАЗВУКОВОГО ДОСЛІДЖЕННЯ НИРОК ТА НИРКОВІ БІОХІМІЧНІ МАРКЕРИ КРОВІ У ХВОРИХ НА ГІПЕРТОНІЧНУ ХВОРОБУ ПІСЛЯ ГЕМОРАГІЧНОГО ІНСУЛЬТУ****Василь З. Нетяженко^{1,2}, Олександр В. Ткачишин¹, Наталія Ю. Ткачишина³, Ольга М. Плєнова¹**

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Вступ. Геморагічний інсульт – серйозне та руйнівне ускладнення артеріальної гіпертензії, яке призводить до підвищеної смертності серед врятованих хворих навіть після раннього відновного періоду. Іншими органами-мішенями артеріальної гіпертензії є нирки, які беруть участь у регуляції артеріального тиску. Дослідження їх особливостей у таких пацієнтів може надати цінні дані щодо можливих причин поганого довгострокового прогнозу у цієї категорії пацієнтів.

Мета дослідження: порівняти параметри ультразвукового дослідження (УЗД) нирок і ниркові біохімічні маркери крові між хворими з артеріальною гіпертензією у стабільній фазі відновного періоду після геморагічного інсульту та пацієнтами з артеріальною гіпертензією, які не мали цереброваскулярних та серцево-судинних подій.

Матеріали та методи. У дослідження було залучено 100 осіб. Було сформовано дві групи хворих: основну (n=64; вік – 52,2±8,41 років, M±SD років) та контрольну (n=36; вік – 51,8±5,92 роки). Основна група складалася із хворих з артеріальною гіпертензією, у яких розвинувся геморагічний інсульт за ≥6 місяців до даного дослідження – субарахноїдальний крововилив (САК) (n=42) або внутрішньомозковий крововилив (ВМК) (n=22). Контрольну групу склали хворі на неускладнену артеріальну гіпертензію. В обох групах пацієнтів визначали ультразвукові показники нирок, а також концентрацію сечовини, креатиніну та сечової кислоти в плазмі крові. Розраховували швидкість клубочкової фільтрації (ШКФ).

Результати. Показники ультразвукового дослідження нирок становили в основній та контрольній групі, відповідно: повздовжній розмір правої нирки – 9,96±1,05 та 11,63±1,26 см, повздовжній розмір лівої нирки – 10,39±0,93 та 11,95±1,23 см, p<0,01 для обох пар. Серед біохімічних показників плазми крові достовірної різниці також досягла концентрація сечової кислоти – 411,21±60,36 та 360,91±75,30 мкмоль/л у відповідних групах (p=0,04). З іншого боку, порівняння ШКФ не продемонструвало різниці між групами дослідження. Основна група характеризувалася більшою поширеністю каменів у нирках – ВШ 5,00 (95 % ДІ, 1,83-13,65). Достовірно вищий рівень частоти розвитку конкрементів виявлено також у двох підгрупах основної групи: для САК – ВШ 3,08 (95 % ДІ, 1,05-9,02), для ВМК – ВШ 13,33 (95 % ДІ, 3,69-48,15). Порівняно з контрольною групою шанс виявити кісту нирки в підгрупі САК становив 3,08 (95 % ДІ, 1,05-9,02), тоді як частота виявлення розширення ниркової миски/чашечок була вищою в підгрупі з ВМК – ВШ 9,17 (95 % ДІ, 2,15-39,06).

Висновки. Отримані дані свідчать про менший повздовжній розмір обох нирок у хворих з артеріальною гіпертензією, які перенесли геморагічний інсульт, що супроводжується більшою частотою утворення ниркових конкрементів у зв'язку з підвищенням концентрації сечової кислоти в плазмі крові. Те ж саме характерно для підгрупи осіб із САК, але з наявністю підвищеного шансу виявити кісти нирок. Що стосується підгрупи з перенесеним ВМК, на додаток до результатів основної групи, розширення ниркової миски/чашечок спостерігається частіше порівняно з пацієнтами з неускладненою артеріальною гіпертензією.

Ключові слова: внутрішньомозковий крововилив, субарахноїдальний крововилив, артеріальна гіпертензія, сечокам'яна хвороба, кіста нирки