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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

ТБИЛИСИ - НЬЮ-ЙОРК

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CARDIOVASCULAR CHANGES IN HUMANBODY AFTER CHANGING POSITION SUPINE TO PRONE

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A significant amount of surgeries and medical manipulations are performed in prone position. This position is supposed to be one of the most complicated for anesthesiologist because of difficulties with airway management, possibility of nerve and soft tissue compression, high risk of postoperative visual loss. Prone position is known to be accompanied by several physiologic changes, but they are not described comprehensively in modern literature.

Hemodynamic changes after turning a person into prone position are usually described as the decreasing of cardiac output [6,7,12]. Several studies did not reveal any cardio-vascular changes in prone position [4,15]. These differences could be explained by a significant heterogeneity of types of the examined prone position, methods and time of examination. Some of them were performed on non-anesthetized volunteers, but another on patients under different types of anesthesia. Significant influence on the results of such investigations can perform basic cardiac function, fasting period and volume preload [8,12].

The most precise methods of hemodynamic monitoring are invasive thus potentially dangerous. That is why the majority of studies were performed on patients under anesthesia. Anesthesia itself has a significant influence on hemodynamic pattern so these data cannot be routinely extrapolated on patients without anesthesia. For hemodynamic examination of non-anesthetized people non-invasive bioimpedance method is one of the most suitable. Some papers have shown its accuracy. Except of critical hemodynamic disturbances [3], this method is reliable for clinical practice. Waldron N. et al. compared bioreactance and transesofageal echocardiography for hemodynamic monitoring of patients during colorectal surgery and found no difference [1]. The same data obtained Matsuda Y. et al. [11] during surgical treatment of pheochromacytoma.

Aim of the study was to examine cardio-vascular changes in non-anesthetized humans after turning them into prone position and the relationship of these changes with age and body mass index.

Material and methods. After approval of local ethics committee, we performed an observational prospective study without control group of 200 patients 18-75 y.o. The study was performed in SI "Sytenko Institute of Spine and Joint Pathology of National Academy of Medical Science of Ukraine" in 2016-2018 years. Examined patients were elected to 1-2 segment lumbar spine surgery. Mean age was 46.9±14.3 y.o., mean body mass index (BMI) was 27,6±4,8 kg/m^2. There were 118 male and 82 female patients. Exclusion criteria were NYHA > 1 (New York Heart Association Functional Classification), ASA > 2 (American Society of Anesthesiologists Classification), low back pain >4 VNS (Visual Numeric Scale). The patients were examined the day before surgery at the same time (3 p.m.) using thoracic electrical bioimpedance (TEB) method by G. Kubicek (ReoComProfessional, Ukraine) and standard non-invasive measurement of blood pressure using patient monitor Utas UM-300. We monitored hemodynamic parameters 3 times: in supine position (SP), 5 min after turning into prone position (PP5) and 20 min after turning into prone position (PP20). We also calculated the duration of cardiac cycle phases. One investigator performed all measurements. Data were analyzed for normal distribution using Colmogorov-Smirnov analysis and continuous variables were expressed as the Mean ± σ. Student T-test was used to compare groups of parameters. We used analysis of variance (ANOVA) for examination of influence of antropometric parameters on hemodynamic changes (IBM SPSS 9.0).

Results and their discussion. The results of our investigation are shown in Table 1.

Table 1. Hemodynamic parameters in supine and prone positions, M±σ

Hemodynamic parameter	Supine position	Prone position 5 min	Prone position 20 min	P1	P2	P3
SBP, mm Hg	126.8±1.9	127.5±1.7	127.3±1.8	>0.05	>0.05	>0.05
DBP, mm Hg	79.8±1.8	83.4±1.8	85.9±1.1	***<0.001***	***<0.001***	>0.05
SV, ml	64.8±2.6	53.5±2.2	55.0±2.3	***<0.001***	***<0.001***	>0.05
SVI, ml/m^2	37.0±1.5	31.8±1.3	32.5±1.3	***<0.001***	***<0.001***	>0.05
CO, l/min	4.7±0.2	4.3±0.3	4.1±0.5	>0.05	***<0.001***	>0.05
SVRI, din·sec·m^2/cm^5	2930.9±119.6	3935.2±198.5	3678.4±156.3	***<0.001***	***<0.001***	***<0.001***
HR, beats/min	73.9±2,4	78.1±2,8	77.0±1.9	>0.05	>0.05	>0.05
Asynchronous contraction, sec	0.0842±0.00274	0.0969±0.00246	0.0965±0.00258	***<0.001***	***<0.001***	>0.05
Isovolumetric contraction, sec	0.0298±0.00017	0.0299±0.00012	0.0298±0.00014	>0.05	>0.05	>0.05
Rapid ejection, sec	0.0529±0.0056	0.0369±0.0039	0.0452±0.00529	***<0.01***	>0.05	>0.05
Reduced ejection, sec	0.2268±0.0040	0.2104±0.0043	0.2191±0.0045	***<0.001***	***<0.05***	***<0.01***
Total ejection period, sec	0.2714±0.0043	0.2450±0.0048	0.2551±0.0049	***<0.001***	***<0.005***	***<0.01***

notes: P1 – Supine Position vs Prone Position 5 min, P2 – Supine Position vs Prone Position 20 min, P3 – Prone Position 5 min vs Prone Position 20 min

We found that systolic blood pressure (SBP) did not change after turning patients into prone position in any period of investigation. Diastolic blood pressure (DBP) increased significantly after turning (PP5) and stayed increased during the time of investigation (PP20). Stroke volume (SV) and stroke volume index (SVI) decreased 5 min after turning into prone position (PP5) by 18% and stayed decreased during the time of investigation. Systemic vascular resistance index (SVRI) increased by 34% after changing of position and then slightly decreased after 20 min.

We have also found significant changes in cardiac cycle. The duration of asynchronous contraction phase increased by 35% and the duration of all ejection phases decreased after changing the position from supine to prone. Rapid ejection reduced by 30%, reduced ejection – by 7%, total ejection by 10%.

We also performed analysis of variance to evaluate the influence of age, sex and BMI on the changes of hemodynamic parameters. We found the influence of age >60 y.o. on increasing of SVRI (p=0.006) and influence of age > 60 y.o. and BMI >25 on decreasing of SVI (p=0.01 and p=0.04 respectively). There was no influence of sex on any variables.

This study was aimed to find the mechanism of physiologic changes in cardio-vascular system after turning the patient into prone position. These changes are usually described as the result of increased intraabdominal pressure that puts direct pressure to inferior vena cava and decreased venous return. Increased thoracic pressure causes decreased left ventricular compliance and filling, resulting in reductions of ventricular volume, stroke volume and cardiac index, while raising central venous pressure [8].

Hemodynamic changes in healthy volunteers after turning to prone position were analyzed by Wadsworth R. et al [16]. They found the decreasing of cardiac index by 20% in knee-chest position and 17% on Relton-Hall frame. We examined patients in plane prone position and we also revealed decreasing of SVI by 18%.

In the recent study [5] Shimizu M. et al. conducted the evaluation of cardiovascular function in supine and prone position in non-anesthetized patients using quantitative gated single-photon emission computed tomography. They revealed the decreasing of SVI by 14% in patients without significant cardiovascular problems. The negative effects of prone positioning were more significant in the patients with poor cardiac function. The authors did not measure blood pressure in the examined patients so they could not make conclusions as to the changes of systemic vascular resistance that play significant role according to our data.

Measurements of blood pressure in different positions (sitting, supine and prone) was performed by Tabara Y. et al. [10]. They found a significant drop of systolic BP and raising of heart rate after turning from supine to prone position. The principal difference of their investigation from our data was the fact that they measured BP 1 minute after changing the position. Our data shows already compensated hemodynamics 5 and 20 minutes after turning. Interestingly, the same result obtained researchers from Iran [14], but they measured BP 15 minutes after turning patients into prone position. In both articles authors described a drop of systolic BP by only 5 mm Hg and no difference of diastolic BP.

Backofen J. [2] et al. examined patients with cardio-vascular problems under general anesthesia. They found that turning of patients into prone position leads to decreasing of SV up to 24%. Mean arterial pressure maintained due to increasing of SVR. Pump B. et al. [9] showed that changing of position leads to sympathetic activation with increasing of heart rate, SVR and norepinephrine level. Similar changes we found in patients without serious cardio-vascular abnormalities.

The only one article we could find according to cardiac cycle changes between supine and prone positions [13]. Authors found only decreasing of cycle length and increasing of pulse transmission time. All another parameters of cardiac cycle did not change significantly, but the investigation was performed only on 8 men aged 24-32 years. Our data require further investigations to explain the obtained postural changes in cardiac cycle.

Thus, we found that after turning people from supine to prone position the most significant changes occur with SVRI, as universal reaction of the circulatory system to changes of environment. Healthy myocardium is able to overwhelm the increased systemic vascular resistance. We found the decreasing of SVI after turning to prone position in whole population. Elderly people and people with increased BMI have limited cardiovascular reserve that probably leads to a more significant reducing of stroke volume index after turning them into prone position. This fact should be recognized when planning anesthesia for surgery in prone position.

Conclusion. We found that in healthy non-anesthetized people turning from supine to prone position leads to significant cardiovascular changes. Stroke volume and stroke volume index decreased by 18%, systemic vascular resistance index increased by 34% and diastolic blood pressure increased by 7%. Changes of SVRI were influenced by age and changes of SVI were influenced by age and BMI.

We also found that positioning prone have been accompanied by changes of cardiac cycle. We revealed shortening of both ejection periods and prolonging of asynchronous contraction period.

According to the obtained results, we suppose that under anesthesia these postural changes could be additionally influenced by vasodilation effect of anesthetics that is extremely dangerous in elderly and obese patients.

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SUMMARY

CARDIOVASCULAR CHANGES IN HUMANBODY AFTER CHANGING POSITION SUPINE TO PRONE

[1]Lyzohub M., [2]Georgiyants M., [3]Vysotska O., [3]Porvan A., [2]Lyzohub K.

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Prone position is known to be accompanied by several physiologic changes, but they are not described comprehensively in modern literature and sometimes controversial.

Aim was to examine cardio-vascular changes in non-anesthetized humans after turning them into prone position and influence on these changes by age and body mass index.

We performed an observational prospective study without control group of 200 (118 male and 82 female) patients 18-75 y.o. The patients were examined the day before elective lumbar spine surgery using thoracic electrical bioimpedance and non-invasive measurement of blood pressure in supine position (SP), 5 min and 20 min after turning into prone position (PP5 and PP20).

Diastolic BP increased significantly after turning (PP5) and stayed increased during the time of investigation (PP20). Stroke volume index (SVI) decreased after turning into prone position (PP5 and PP20) by 18%. Systemic vascular resistance index (SVRI) increased by 34% (PP5). The duration of asynchronous contraction phase increased by 35% and the duration of all ejection phases decreased after changing the position from supine to prone. Rapid ejection reduced by 30%, reduced ejection – by 7%. We found the influence of age >60 y.o. on increasing of SVRI (p=0.006) and influence of age > 60 y.o. and BMI > 25 on decreasing of SVI (p=0.01 and p=0.04 respectively).

In healthy non-anesthetized people turning from supine to prone position leads to decreasing of SVI by 18%, increasing of SVRI by 34% and increasing of diastolic blood pressure increased by 7%. Changes of SVRI are influenced by age and changes of SVI are influenced by age and BMI. Positioning prone are accompanied by shortening of both ejection periods and prolonging of asynchronous contraction period.

Keywords: cardio-vascular changes, Stroke volume index, Systemic vascular resistance index, body mass index.

РЕЗЮМЕ

ИЗМЕНЕНИЯ СЕРДЕЧНО-СОСУДИСТОЙ СИСТЕМЫ ПРИ ПОВОРОТЕ ЧЕЛОВЕКА ИЗ ПОЛОЖЕНИЯ НА СПИНЕ В ПОЛОЖЕНИЕ НА ЖИВОТЕ

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Положение на животе сопровождается физиологическими изменениями, которые весьма противоречиво описаны в современной литературе.

Цель исследования – определить изменения гемодинамики, которые происходят у человека после поворота со спины на живот и влияние на них возраста и индекса массы тела.

Проведено обсервационное проспективное исследование без контрольной группы у 200 пациентов (118 мужчин и 82 женщины) в возрасте 18-75 лет. Пациенты были обследованы за сутки до плановой операции на поясничном отделе позвоночника с использованием грудной реографии и неинвазивного измерения артериального давления в положении на спине (SP), спустя 5 и 20 мин после поворота на живот (PP5 и PP20).

Диастолическое АД достоверно увеличивалось после поворота и оставалось повышенным до конца исследования. Ударный индекс (УИ) снижался после поворота на 18% (PP5 и PP20). Удельное периферическое сосудистое сопротивление (УПСС) возрастало на 34% (PP5). Длительность фазы асинхронного сокращения возрастала на 35%, а длительность всех фаз изгнания уменьшалась: фаза быстрого изгнания на 30%, фаза замедленного изгнания на 7%. Дисперсионный анализ выявил влияние возраста > 60 лет на увеличение УПСС (p=0.006) и влияние возраста > 60 лет и индекс массы тела >25 на снижение УИ (p=0.01 и p=0.04, соответственно).

У неанестезированных лиц поворот из положения на спине в положение на животе приводит к снижению УИ на 18%, увеличению УПСС на 34% и увеличению диастоли-

ческого АД на 7%. Изменения УПСС зависят от возраста, а изменения УИ – от возраста и массы тела. Смена положения тела приводит к укорочению обоих периодов изгнания и удлинению периода асинхронного сокращения.

რეზიუმე

გულ-სისხლძარღვთა სისტემის ცვლილებები ადამიანის ზურგიდან მუცლის პოზიციაში გადაადგილების შემთხვევაში

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მუცლის პოზიციაში ყოფნას თან სდევს ფიზიოლოგიური ცვლილებები, რის შესახებაც ლიტერატურაში არაერთგვაროვანი მონაცემებია.

კვლევის მიზანს წარმოადგენდა იმ ჰემოდინამიკური ცვლილებების შესწავლა, რომლებსაც ადგილი აქვს ადამიანის პოზიციის შეცვლის შემთხვევაში - ზურგზე წოლის მდგომარეობიდან მუცელზე პოზიციაში გადასვლის დროს და აღნიშნულ პროცესზე ასაკის და სხეულის მასის ინდექსის გავლენის განსაზღვრა.

ჩატარდა ობსერვაციული პროსპექტული კვლევა 18-75 წლის 200 პაციენტზე (118 მამაკაცი და 82 ქალი). პაციენტები გამოკვლეული იყო გეგმიური ოპერაციის წინ ხერხემლის წელის არეში გულ-მკერდის რეოგრაფიის გამყენებით და არტერიური წნევის გაზომვით ზურგზე მდგომარეობიდან მუცელზე გადაბრუნების პირობებში 5 და 20 წუთის შემდეგ (PP5 и PP20). დიასტოლური არტერიული წნევა სარწმუნოდ გაიზარდა გადაბრუნების შემდეგ და ასეთი დარჩა კვლევის ბოლომდე. გადაბრუნების შემდეგ დარტყმითი ინდექსი (დი) შემცირდა 18% (PP5 и PP20), პერიფერიული სისხლძარღვოვანი ხვედრითი წინაღობამ (პსხწ) მოიმატა 34% (PP5). ასინქრონული შევიწროვების ფაზის ხანგრძლივობა შემცირდა 35%, ყველა ფაზის განდევნის ხანძლივობა შემცირდა: სწრაფი განდევნის ფაზა – 30%, შენელებული განდევნის ფაზა - 7%. დისპერსიულმა ანალიზმა გამოავლინა ასაკის (>60 წ.) გავლენა პსხწ-ის მაჩვენებლის მატებაზე ($p=0.006$), ასევე 60 მეტი წლისა და სხეულის მასის ინდექსის 25-ზე მეტი მაჩვენებლის გავლენა დი-ის შემცირებაზე ($p=0.01$ და $p=0.04$, შესაბამისად).

გამოკვლევამ აჩვენა, რომ ზურგიდან მუცლის პოზიციაში გადასვლის შემთხვევაში დი მცირდება 18%-ით, პსხწ-ის და დიასტოლური არტერიული წნევის მაჩვენებლები მატულობს 34% და 7%-ით, შესაბამისად. პსხწ-ის ცვლილება დაკავშირებულია ასაკთან, დი-ის – ასაკთან და სხეულის მასის ინდექსთან. სხეულის მდგომარეობის შეცვლა იწვევს განდევნის ორივე პერიოდის შემცირებას, ხოლო ასინქრონული შევიწროვების პერიოდის გახანძლივებას.

КАПСУМЕН В ЛЕЧЕНИИ СИНДРОМА РАЗДРАЖЕННОГО КИШЕЧНИКА

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Синдром раздраженного кишечника (СРК) – распространенное функциональное кишечное расстройство, частота которого варьирует в пределах от 5% до 20% случаев в популяции в зависимости от географического региона и критериев, применяемых для диагностики [11,16]. Определяющими признаками СРК является боль в животе в ассоциации с изменением кишечной функции, проявляющейся преобладанием диареи (СРК-Д), либо запоров (СРК-З) или их чередованием (СРК-С-смешанный вариант). Другие ассоциированные симптомы включают вздутие живота, ощущение избыточного газообразования и чувство неполного опорожнения кишечника. Спектр абдоминальной боли варьирует от незначительной до нарушающей жизнедеятельности пациента. Несмотря на значительное распространение СРК по всему миру, диагностика и ведение пациентов с СРК остаются вызовом для систем здравоохранения всех стран. Выбор соответствующей терапии для пациентов с СРК осложняется гетерогенностью патофизиологических механизмов его развития и разнообразием популяции пациентов, также, как и широким спектром неспецифических симптомов, которые могут испытывать пациенты.

Один из главных авторов внедрения в клиническую практику диагноза СРК профессор Douglas A. Drossman в 1998 г. однозначно высказался, что СРК – биопсихосоциальное заболевание, в 2006 г. он же писал: «В последние годы гистологические исследования показали, что различия между функциональными и органическими изменениями стали размытыми», а в 2013 году: «СРК – совокупность симптомов с гетерогенными определяющими факторами» [цит. по 1,5,8]. Диагноз СРК требует вдумчивого подхода, ограниченных диагностических тестов и тщательного наблюдения. Для большинства пациентов, когда присутствуют диагностические критерии СРК и отсутствуют симптомы тревоги, необходимость выполнения диагностических тестов должна быть минимальной [9].