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HYPOTENSIVE EPISODES ON PROGRAM HEMODIALYSIS DURING RENAL REPLACEMENT THERAPY: THE LATEST APPROACHES TO DIAGNOSIS AND PREVENTION

Ortiqboyev J.O., Fakhriev J.A.

Tashkent Pediatiric Medial Institute

✓ ***Resume***

Patients with end-stage chronic kidney disease who received hemodialysis therapy sequentially on profiles 3 and 5 were included in an open-label prospective clinical study. the quality of life of patients, helps to prevent the development of complications.

Key words: hemodialysis, sodium profiling, ultrafiltration, blood pressure, quality of life, complications, hypotension.

ГИПОТЕНЗИВНЫЕ ЭПИЗОДЫ НА ПРОГРАММНОМ ГЕМОДИАЛИЗЕ В ХОДЕ ЗАМЕСТИТЕЛЬНОЙ ПОЧЕЧНОЙ ТЕРАПИИ: НОВЕЙШИЕ ПОДХОДЫ К ДИАГНОСТИКЕ И ПРОФИЛАКТИКЕ

Ортикбоев Ж.О., Фахриев Ж.А.

Ташкентский педиатрический медицинский институт

✓ ***Резюме***

В открытое проспективное клиническое исследование были включены больные с терминальной стадией хронической болезни почек, получавшие терапию гемодиализом последовательно на профилях 3 и 5. У больных на программном гемодиализе при регуляции профилирования натрия и ультрафильтрации происходит стабилизация артериального давления, положительная коррекция белково-энергетического баланса, что улучшает качество жизни больных, способствует профилактике развития осложнений.

Ключевые слова: гемодиализ, профилирование натрия, ультрафильтрация, артериальное давление, качество жизни, осложнения, гипотония.

ДАСТУРЛИ ГЕМОДИАЛИЗ ТЕРАПИЯСИ ПАЙТИДА ГИПОТЕНЗИВ ЕПИЗОДЛАРНИ: ДИАГНОСТИКАСИ ВА ОЛДИНИ ОЛИШНИНГ СЎНГГИ ЁНДАШУВЛАРИ

Ортиқбоев Ж.О., Фахриев Ж.А.

Тошкент педиатрия тиббиёт институти

✓ ***Резюме***

Сурункали буйрак касаллиги билан беморларни очиқ истиқболли клиник профиларни ўрганиш режимларни 3 ва 5 бўйича изчил гемодиализ даволаш ўз ичига олган. Дастурлаштирилган гемодиализдаги беморларда натрий профилини тартибга солиш ва ултрафилтрлаш билан қон босими барқарорлашади ва оқсил-енергия баланси ижобий кузатилади, бу беморларнинг ҳаёт сифатини яхшилайди ва асоратларнинг олдини олишга ёрдам беради.

Калит сўзлар: гемодиализ, натрияни профилаш, ультрафильтрация, артериальное қон босими,хаёт сифати, асоратлар, гипотония.

Relevance

Intradialytic hypotension is the most common complication of hemodialysis, significantly affecting the results of treatment. Therefore, the development of measures to prevent this complication or at least reduce its frequency and severity is one of the main directions for improving the adequacy of hemodialysis in patients with chronic kidney disease and those receiving treatment with program hemodialysis (HD), the most common complication of the dialysis procedure is intradialysis hypotension. (IDG). IDH is considered an urgent clinical problem not only because it accompanies up to 20–30% of all HD procedures [1], but also because approximately 17.8% of symptomatic IDH require medical intervention [2]. The urgency of the problem of IDH is due to the episodes of ischemia of vital organs, including the heart and brain, that occur against its background during the hemodialysis procedure, which are often asymptomatic. Severe syndialytic hypotension (synonym: IDH) causes local disturbances in myocardial contractility and its “stunning” or “stunning”, which, with frequent repetition of such episodes, leads to fibrosis, systolic dysfunction, and increased cardiovascular mortality [3, 4]. So, in the work of J. O. Burton et al. talks about a direct relationship between severe IDH and impaired local myocardial contractility [5]. IDH is the cause of arrhythmias. The tolerability of HD procedures worsens, which often leads to a reduction in dialysis time. No less important is the increased risk of thrombosis and loss of vascular access in the event of IDH [6]. The most severe episodes of IDH occur in people with low pre-dialysis systolic blood pressure (BP) and increased vascular stiffness, which leads to even greater ischemia of vital organs [7,8]. Symptoms of IDH are dizziness, nausea, vomiting, and sweating. The most dangerous symptoms include angina pectoris, arrhythmias, loss of consciousness, convulsions and cardiac arrest. There are various definitions of IDH, including those based on episodes of low systolic BP (MEAN PRESSURE) <90 mmHg. Art. or decrease in intradialytic mean arterial pressure by 20–30 mm Hg. Art., accompanied by clinical symptoms (weakness, sweating, nausea, vomiting, flickering of “flies” before the eyes, in severe cases, loss of consciousness), which is most useful in clinical practice, since in this case the strongest association with increased mortality was found . There are different approaches to the prevention of IDH: large meals should be avoided during HD, individualization of the temperature of the dialysis solution (0.5 °C below body temperature), control of unrecognized dehydration, use of bicarbonate instead of acetate dialysis, and the abolition of antihypertensive therapy are necessary.

At the same time, the most effective prevention methods are to reduce the rate of fluid removal during the dialysis procedure or the UF rate: increase the dialysis time, control the interdialysis fluid intake (restriction of salt intake), prescribe additional procedures. Currently, new approaches to the prevention of IDH are increasingly being used, such as software and hardware systems for controlling the rate of ultrafiltration. This approach is based on continuous monitoring of the patient's BP. The results of measuring the patient's blood pressure are stored in the patient's personal record, which allows for an individual approach to each patient. The computer self-learning algorithm analyzes the dynamics of blood pressure during the first few procedures and subsequently reacts to its changes, maintaining blood pressure at target values, controlling the UF rate. If there is a tendency to develop IDH, the algorithm either reduces the UF rate or completely stops UF for a short period of time, sufficient to replenish intravascular volume from the interstitial space and stabilize BP. When the target BP values are reached, the UV rate is restored automatically, reaching the target UV if possible. The advantage of this approach is the constant online monitoring of blood pressure and an immediate response to the tendency to develop IDH, i.e., the emphasis is on the prevention of episodes of symptomatic syndialytic hypotension. At the same time, the computer algorithm does not exceed the specified limiting UV rate, preventing high UV rates (over 12.4 ml/kg/h), which leads to an increase in mortality both according to the literature and our own data [9,10]. However, literature data on the application of a computerized UV control algorithm are very scarce. In order to test the presented hypothesis in real practice, the present study was carried out.

The purpose of the study was to evaluate the effectiveness of various approaches to the correction of hemodynamics and the prevention of IDH episodes; comparison of the incidence of episodes of hypotension with and without computerized ultrafiltration control.

Materials and methods

The material for the study was the data of a comprehensive examination of patients in the city of Tashkent at the Republican Specialized Scientific and Practical Medical Center for Nephrology and Kidney Transplantation. A total of 35 patients who were on HD in a dialysis center during the entire observation period were included in the analysis. The average age of the patients was 52 years, among them there were 16 women and 19 men. The provided dialysis dose was 1.89 ± 0.3 (spKt / V), the mean arterial pressure before the HD session was 124.6.6 ± 27.7 and 71.3 ± 16.3 mm Hg. Art., effective time - 255.6 ± 18.2 min, mean UV rate - 8.03 ± 3.6 ml/kg/h, mean UV volume - 2351.2 ± 1125.6 ml, blood flow - 325, 4 ± 46 ml / min. In patients, various approaches to the prevention of IDH were used: the standard approach (during the first 4 hemodialysis sessions, predialysis BP was measured before the patient was connected to the device; then, BP was measured regularly during the HD session at least 1 time per hour or more often) and the approach with using a computerized UV control unit (automatic pressure control system - ASKD, BioLogic RR Comfort option), built into the “artificial kidney” device (B. Braun Dialog + Evolution), which analyzed the curves of blood pressure changes, using an intelligent approach system in subsequent dialysis sessions , automatically setting the BP limits individually for each specific patient, which made it possible to get an idea of the BP data, forming measurement intervals. When the lower limit of mean arterial pressure was reached, the system partially or completely limited the UF rate, notifying the staff, which made it possible to promptly respond to episodes of IDH. - due to the need to collect statistical data for compiling BP curves and predicting episodes of IDH. Starting from the 4th procedure, BP measurement intervals were set automatically by the algorithm. The last measurement was taken after the patient was disconnected from the device (post-dialysis BP). Average post-dialysis weight was 67.9 ± 11.4 kg, dry weight according to bioimpedance analysis was 67.4 ± 11.2 kg. The average post-dialysis weight exceeded the measured "dry weight" by 0.52 kg, which is generally accepted ("dry weight" + 0.5 kg = post-dialysis weight). The study used averaged BP data measured before, during and after HD sessions over the entire observation period. The average values of measurements for the entire observation period were used as variables. An episode of hypotension was defined as a decrease in mean arterial pressure <90 mm Hg. Art, decrease in mean arterial pressure during the procedure by 20 mm Hg. Art. and more and the manifestation of clinical symptoms. A low pre-dialysis level of mean arterial pressure, which is a risk factor for the development of IDH on HD, was considered to be <100 mm Hg. art. The measurement was performed using a built-in unit for non-invasive BP measurement in the “artificial kidney” B. Braun Dialog+ apparatus. Statistical analysis was carried out using the statistical program Statistica 6.0. (StatSoft Inc., USA). Standard methods of descriptive and variation statistics were used: calculation of mean values, interquartile range and standard deviation with a normal distribution of values, or determination of the median[9]. To compare variables with a normal distribution, Student's t-test was used. When comparing data with a non-normal distribution, the Wilcoxon test was used. Differences were considered statistically significant at $p<0.05$.

Results and discussions

The study compared pre-dialysis, post-dialysis levels of mean arterial pressure, diastolic BP (DBP) and mean BP, as well as intradialytic BP variations in patients in whom various approaches to correcting hypotension were used. As a result of the comparison, the average predialysis mean arterial pressure and DBP with the standard approach turned out to be statistically significantly lower than with the use of ASKD: 124.6 ± 27.74 and 74.45 ± 21.13 mm Hg. Art. and 133.2 ± 25.8 and 79.3 ± 20.5 mm. The data of post-dialysis MEAN ARTERIAL PRESSURE and DBP differed: BP with ASKD was higher than with standard therapy - 125.7 ± 24 and 75.9 ± 18.3 mm Hg. Art. and 114.3 ± 24.4 and 71.2 ± 16.3 mm Hg. Art. ($p<0.001$; $p<0.001$, respectively). The data of intradialysis variations showed statistical significance: when using ASKD, BP values were higher ($p = 0.03$; $p = 0.02$) - 124 ± 2 0.5 and 75.9 ± 14.2 and 110.2 ± 17.3 and 68.3 ± 17.9 mm Hg. Art. (Fig. 2). The mean blood pressure data in the study of intradialysis variations had a similar result: 82.5 ± 13.9 and 91.5 ± 15.6 mm Hg. Art. ($p = 0.01$).

Thus, the use of the UV control system resulted in an increase in intradialytic mean arterial pressure by 14 mm Hg. Art., DBP - by 8 mm Hg. Art., and mean blood pressure - by 10 mm Hg. Art. The frequency of IDH during the procedures was 26.2% with a conservative approach versus 8.3%

with the use of an automatic UF rate control unit (Fig. 3). The average UV rate did not show significant differences in values and was 8.2 ml/kg/h with the standard approach versus 7.9 ml/kg/h with the Biologic RR Comfort algorithm. The average procedure time when applying the UV rate control algorithm increased slightly - by 3 min, which did not lead to an increase in the Kt / V coefficient. In patients using the UV rate control algorithm, the phosphorus level decreased and entered the reference values – 1.8 mmol/l versus 1.5 mmol/l; however, the data did not reach statistical significance ($p = 0.07$). The number of interventions with hyperosmolar glucose solution naturally decreased - 86 versus 27. The clinical significance of IDH during the HD procedure is currently an urgent problem, which is devoted to a large number of publications in the literature. In light of the available data, it can be concluded that significant BP variations during a HD session have a negative impact on clinical outcomes [11]. At the same time, the occurrence of episodes of hypotension during the dialysis procedure, especially repeated, severe ones (decrease in mean arterial pressure <30 mm Hg), is no less a formidable complication and not only worsens the tolerability of HD and requires the intervention of medical personnel (off UV, interventions hyperosmolar glucose solution, saline infusion, interruption of the HD procedure), which often affects the quality of treatment in general [12], but also affects the increase in the frequency of cardiovascular events, including patient death [13]. IDH is associated with repeated episodes of ischemia and impaired local myocardial contractility, which leads to myocardial fibrosis and the development of heart failure [14]. This leads to an increase in BP variations and expansion of BP limits in patients with high UF rate, leading to complications [15]. This fact caused difficulties, since when trying to achieve a “dry weight” to normalize blood pressure, practitioners aggressively reduced blood pressure to target values, which could lead to increased mortality. This study is devoted to the study of the spread, prevention and correction of IDH. We analyzed 2 groups of patients, having individual BP data of patients included in the study for the entire observation period, which were recorded during HD procedures and recorded in the Nexadia medical information system. A comparison was made between the standard approach in the prevention and correction of IDH, the automatic UV rate control system, and the “dry weight” correction method to achieve target BP numbers. We were able to demonstrate not only the advantage in the prevention of IDH of ASKD, which directly regulates the UF rate: one of the side effects of the decrease in the prevalence of IDH was a decrease in the number of interventions with hyperosmolar glucose solution to correct an episode of IDH, which reduced the burden on medical staff. Contrary to expectations, the level of Kt / V in the studied groups did not differ significantly. At the same time, the average content of phosphates in patients treated with the algorithm was within the reference limits, in contrast to patients who received the procedure without the algorithm. This may be due to an increase in effective dialysis time.. The results of our work in this part largely coincide with the literature data, for example, with the review by C. Chazot and G. Jean, where the duration of dialysis was directly related to a decrease in the level of phosphates [16]. in the group with BP <120 mm Hg. Art. with intensive BP control, a 27% reduction in overall mortality and a 43% lower risk of death from cardiovascular disease were observed [17]. However, there was a higher incidence of adverse events in this group, such as hypotension, syncope, acute kidney injury, or renal failure. Our data (post-dialysis mean arterial pressure using the BioLogic RR Comfort algorithm was 125.8 mmHg) were close to the target results of this study. This indicates a decrease in cardiovascular risk for these patients, which is relevant for the dialysis population. n our study, in patients with a standard approach to the correction and prevention of IDH, post-dialysis mean arterial pressure was 115.7 mm Hg. Art., which provokes an increase in cardiovascular mortality and increases the risk of hypotension, which also coincides with the data of the SPRINT study. Taking into account the 18% reduction in IDH prevalence using the BioLogic RR Comfort algorithm, we can talk about a good clinical outcome. Our data are consistent with a large study including 15 dialysis centers in Italy, in which the reduction in the prevalence of IDH was 25% [18]. We consider the study of the problem in real clinical practice and the lack of selection of patients when included in the study (except for the tendency to hypotension) to be the strength of the work.

Conclusion

IDH in the presence of high UF rates remains a frequent and potentially dangerous complication of the HD procedure, which worsens the long-term prognosis of HD patients, mainly due to an increase in cardiovascular morbidity and mortality. A new method for the prevention and correction of hypotension during a dialysis procedure using ASKD allows you to timely reduce the UF rate, preventing the development of an episode of hypotension, improving the achievement of both pre- and post-dialysis target BP values, as well as its intradialysis variations. Data were obtained on a decrease in the frequency of IDH from 26 to 8%. A relationship was noted between the use of ASKD and a decrease in the number of interventions with hypertonic glucose solution.

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