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HAEMODIALYSIS EFFECTS ON RESPIRATORY FUNCTION

SUMMARY

Chronic renal failure is a progressive and irreversible impairment of renal function. Such a condition disturbs the functions of almost all organs and organ systems, including lungs. In the end-stage disease these patients experience a special form of pulmonary oedema called “uraemic lung”.

The objective of this study was to present the effect of haemodialysis and interdialysis weight gain (water) on ventilating lung function.

The study enrolled 32 patients with chronic renal failure that had been treated with repeated haemodialyses. The patients were separated into two groups: Group 1 – patients with interdialysis liquid gain < 5% and Group 2 – patients with interdialysis liquid intake > 5%. All the patients had body plethysmography and gas analyses done both before and after haemodialysis.

The results obtained show that haemodialysis improves the ventilating function parameters – VC, FVC, FEV_1. Dynamics of recovery of ventilating function parameters in our patients, after haemodialysis, indicates the obstructive type disorder with disfunction of small airways. Patients with greater interdialysis liquid gain have more expressive changes in ventilating function (FEV_1) and poorer recovery after the dialysis.

Different values of interdialysis gain of liquid did not have influence on haemodialysis effects on parameters of gas analyses and acid-base balance in blood.

The results lead us to a conclusion that haemodialysis has a positive effect on pulmonary ventilating function, but this effect is poorer in patients with greater interdialysis weight gain. Gas analyses and acid-base balance in blood are not reliable parameters of dyalisis (adequacy) efficacy.

***Key words*: chronic renal failure, haemodialysis, respiratory function**

INTRODUCTION

Chronic renal failure is a progressive and irreversible impairment of renal function. Such a condition disturbs the functions of almost all organs and organ systems (1). The disturbed electrolyte status, as well as acid-base disbalance are the findings associated with chronic renal failure in its end-stage – uraemia. This particularly is the basis for further failures in function of all organic systems. If active treatment with dialysis or kidney transplantation are not applied immediately, the outcome is lethal (2).

No organ in a body is spared from the negative effect of uraemia, neither are lungs. Many complications in the respiratory system have been described in patients with chronic renal failure, while much less is known about the effects of haemodialysis and other therapeutic procedures on lungs. The most frequently described lung complications in these patients are: uraemic lung, pulmonary infections, uraemic pleurisy and uraemic calcifications (3, 4).

Uraemic lung is a pulmonary oedema that differs from pulmonary oedema of cardiac origin or oedema occurring in acute respiratory distress syndrome in adults (ARDS). As a complication, it appears in chronic renal failure and in patients treated with repeated haemodialyses. In these patients, liquid is accumulated in lung interstice that is removed at time of each haemodialysis. This hypothesis is proved by measuring the water presence in the lungs by means of indocyanine green diluting method and after haemodialysis (5,6). Symptoms of the uraemic lung are mild in comparison with x-ray findings, and very often are completely absent; it is therefore called sub-clinical pulmonary oedema. From the radiological point of view, uraemic lung is seen as a butterfly-shaped picture with perihylus trunk localisation and radial wings exposition. The reasons for such distribution of the liquid have not been completely known (7).

In patients that suffer from end-stage renal failure treated with repeated heamodialyses, there are changes in pulmonary function that, most commonly, do not show any clear symptoms and signs. Changes in respiratory dynamics (breathing dynamics), muscular and ventilating function and gas exchange are frequent, if not permanent complications in uraemia. Pulmonary disfunction is the result of direct influence of uraemic toxins and oedematous liquid that is accumulated in uraemic lung. Apart from direct influence of the illness alone on the lungs, therapeutic procedures and haemodialysis also show their negative effect that is mainly reflected in a sudden change of body weight after haemodialysis and oscillations in partial pressures in blood gases (6,7).

OBJECTIVE

The objectives of this study are:

- Estimation of haemodialysis efficiency in pulmonary function recovery in patients suffering from end-stage renal failure treated with repeated haemodialyses.
- Estimation of the influence of interdialysis gain of weight (liquid) on patient's pulmonary function.

MATERIAL AND METHODS

The study enrolled 32 patients suffering from end-stage renal failure who were treated with repeated haemodialyses at the Center for Haemodialysis, Clinical Center of Banja Luka. The mean duration of haemodialysis in all these patients was from 180 to 240 minutes (individual approach), three times a week. The dialysers used were produced by Gambro and Frezenius companies with controlled ultrafiltration, and bicarbonate modul were applied. Haemodialysis was performed on the following dialysers: E_4H, F_6, F_{60}, F_{60s}. Heparinisation was continuous with 4000-5000 i.u. of heparin per patient. No patients had primary pulmonary disease nor had haemodynamic instability during haemodialysis.

Out of the total, 16 studied patients were females, while 16 were males. The average age was 51 (25 – 75 years of age). The average haemodialysis duration in all the patients was 52 months (9 – 89 months).

In patients with end-stage renal failure, according to the special protocol, the "pure weight" was determined. During every haemodialysis in each following visit, the patients needed to lose the difference (excess of kg) in comparison with the "pure weight" value. This difference in kilograms is the interdialysis weight gain and is caused by ingestion or catabolism of water (interdialysis water gain).

During the process of result evaluation, two groups of patients have been established:

1 – patients with interdialysis weight gain < 5%

2 – patients with interdialysis weight gain > 5%

All the patients had body plethysmography and gas analysis of capillary blood done, both before and after haemodialysis.

Body plethysmograph is a device which determines specific ventilating function parameters, and it also provides spirometry results. The following parameters were determined:

1. Vital capacity (VC) is a maximum volume of air that a person can exhale from the lungs, in a way to make a maximal inspiration first, and then maximal expiration.
2. Forced vital capacity (FVC) is a volume of air exhaled with maximum effort (with maximum speed), after maximal inspiration.
3. Forced expiratory volume in the first second (FEV_1) is a part of FVC exhaled in the first second.
4. Specific resistance in airways (SRtot) is a total resistance corrected for the ITGV value.

The values obtained with body plethysmography were computer processed according to the following inputs: body weight, height, sex and date of birth. Due to those facts, having performed measurings, results obtained were as anticipated (ideal) including those obtained for the particular patient. In our case, the test was performed on Jaeger plethysmograph (volume constant model).

The following parameters were obtained by g*as analyser* of capillary blood (Radiometer ABL 500):

1. values of partial pressure of arterial oxygen (pO_2)
2. parameters for acid – base balance in blood:
   - pH of arterial blood (PH)
   - standard base excess (SBE)
   - actual bicarbonates (HCO_3^-)

Blood for gas analyses was taken from ear-lap (capillary blood).

The results were processes by standard statistical method (Student's t-test for small dependent samples, "difference method") and shown as mean ± standard mean error ($\overline{X} \pm S_X$). Significance in difference between the mean in the observed groups before and after haemodialysis was tested, aimed at monitoring changes of pulmonary function parameters and capillary blood gas analysis.

Values with $p < 0.05$ are considered statistically significant.

RESULTS

Figure 1 shows the results of VC measurements. There are VC means ($\overline{X}$) measured before (A) and after haemodialysis (B) in patients with interdialysis weight gain (liquid) less than 5% (1) and greater than 5% (2). Statistic analysis by means of "difference method" showed that there was a very high, statistically significant difference ($p < 0.01$) between the VC values before and after haemodialysis in both tested groups. Apart from the stated comparisons, a relation between the VC values measured before haemodialysis in both groups of patients (groups 1 & 2) was determined. It was found that VC values obtained before the haemodialysis had a lower statistically significant difference ($p < 0.05$) in group 1 compared to group 2.

Figure 2 shows the results of FVC measurings. There are means ($\overline{X}$) of FVC measured before (A) and after haemodialysis (B) in patients with interdialysis weight gain (liquid) less than 5% (1) and greater than 5% (2). Statistical analysis by means of "difference method" showed that there were no statistically significant differences ($p > 0.05$) between FVC values before and after haemodialysis in both tested groups. The comparison of relation between the FVC values before haemodialysis in both groups of patients (groups 1 & 2) showed that the obtained values had a lower statistically significant difference ($p<0.05$) in group 1 than the same values in the group 2.

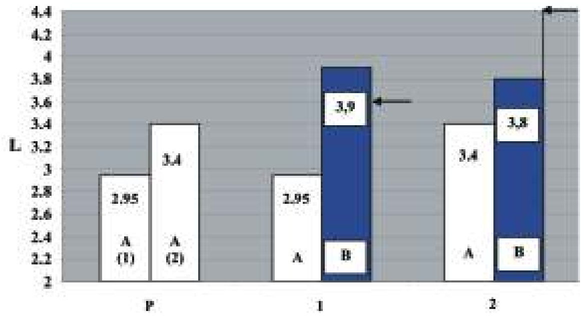

Figure 1. Influence of haemodialysis on VC values

P. relation between VC values measured before haemodialysis in groups 1 & 2 patients
1. patients with interdialysis weight gain (liquid) < 5%
2. patients with interdialysis weight gain (liquid) > 5%

A VC means before haemodialysis
B VC means after haemodialysis
← Referral VC values (mean value)

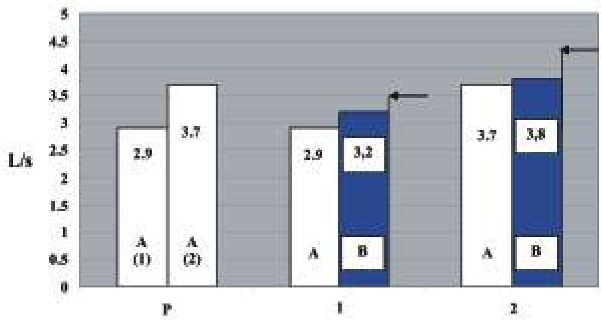

Figure 2. Influence of haemodialysis on FVC values

P. relation between FVC values measured before haemodialysis in groups 1 & 2 patients
1. patients with interdialysis weight gain (liquid) < 5%
2. patients with interdialysis weight gain (liquid) > 5%

A FVC means before haemodialysis
B FVC means after haemodialysis
← Referral FVC values (mean value)

Figure 3 shows forced expiratory volume in one second (FEV_1). There are means ($\overline{X}$) of FEV_1 measured before (A) and after haemodialysis (B) in patients with interdialysis weight gain (liquid) less than 5% (1) and greater than 5% (2). Statistic analysis by means of "difference method" showed that there was a very high statistically significant difference ($p < 0.01$) between FEV_1 values before and after haemodialysis in group 1, while in the group 2, it was determined that there was no statistically significant difference ($p > 0,05$) between measurings before and after haemodialysis . The comparison of relation between FEV_1 in both groups of patients (groups 1 & 2) showed that the obtained values had a lower statistically significant difference ($p < 0.05$) in group 1 than the same values in the group 2.

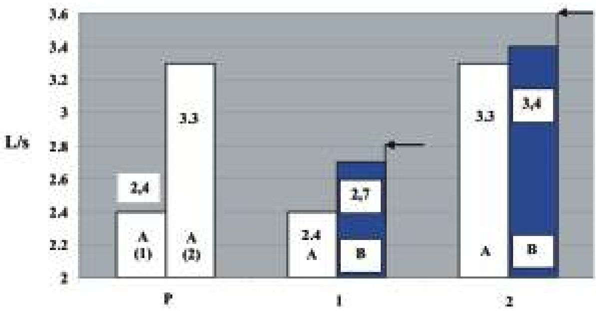

Figure 3. Influence of haemodialysis on FEV_1

P. relation between FEV_1 values measured before haemodialysis in groups 1 & 2 patients
1. patients with interdialysis weight gain (liquid) < 5%
2. patients with interdialysis weight gain (liquid) > 5%
A FEV_1 before haemodialysis
B FEV_1 after haemodialysis
← Referral FEV_1 (mean value)

Figure 4 shows results of SRtot. There are means ($\overline{X}$) of SRtot measured before (A) and after haemodialysis (B) in patients with interdialysis weight gain (liquid) less than 5% (1) and greater than 5% (2). Statistic analysis by means of "difference method" showed that there were not statistically significant differences ($p>0.05$) between SRtot values before and after haemodialysis in both groups. The comparison of relation between the SRtot values before haemodialysis in both groups of patients (groups 1 & 2) showed that the obtained values had a lower statistically significant difference ($p<0.05$) in group 1 than the same values in the group 2.

Figure 5 shows results of pO_2. There are means ($\overline{X}$) of pO_2 before (A) and after haemodialysis (B) in patients with interdialysis weight gain (liquid) less than 5% (1) and greater than 5% (2). Statistic analysis by means of "difference method" showed that there were no statistically significant differences ($p>0.05$) between values of pO_2 before and after haemodialysis in both tested groups. It has been found that there was no statistically significant difference ($p>0.05$) between the two groups (groups 1 & 2) in the values of pO_2 measured before haemodialysis.

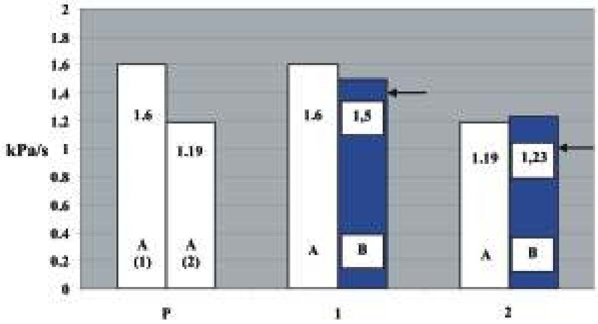

Figure 4. Influence of haemodialysis on SRtot values

P. relation between SRtot values measured before haemodialysis in groups 1 & 2 patients
1. patients with interdialysis weight gain (liquid) < 5%
2. patients with interdialysis weight gain (liquid) > 5%
A SRtot means in airways before haemodialysis
B SRtot means in airways after haemodialysis
← Referral SRtot values in airways (mean value)

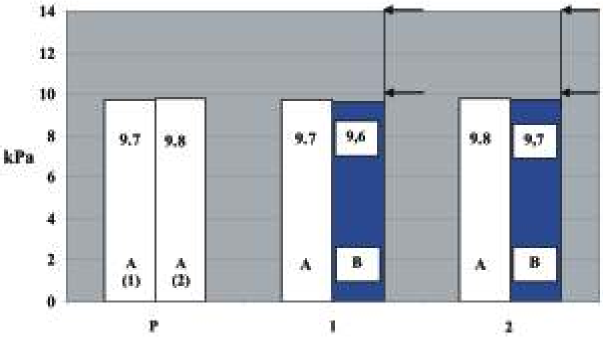

Figure 5. Influence of haemodialysis on values of pO_2

P. relation between pO_2 values measured before haemodialysis in groups 1 & 2 patients
1. patients with interdialysis weight gain (liquid) < 5%
2. patients with interdialysis weight gain (liquid) > 5%
A pO_2 means before haemodialysis
B pO_2 means after haemodialysis
← Normal values of pO_2

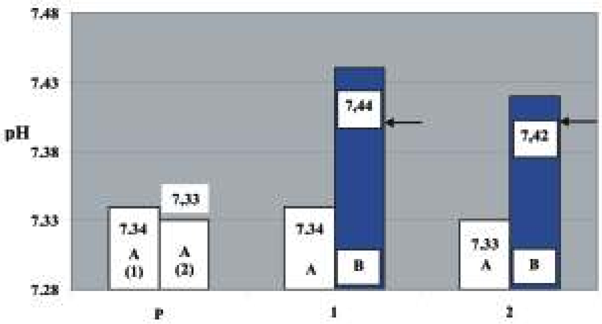

Figure 6. Influence of haemodialysis on pH values of arterial blood

P. relation between pH values measured before haemodialysis in groups 1 & 2 patients
1. patients with interdialysis weight gain (liquid) < 5%
2. patients with interdialysis weight gain (liquid) > 5%
A pH means before haemodialysis
B pH means after haemodialysis
← Normal values of pH

Figure 6 shows the results of pH measurements. There are means ($\overline{X}$) of pH measured before (A) and after haemodialysis (B) in patients with interdialysis weight gain (liquid) less than 5% (1)

and greater than 5% (2). Statistic analysis by means of "difference method" showed that there was a high statistically significant difference ($p<0.01$) in pH values before and after haemodialysis in both tested groups. It was found that there was no statistically significant difference ($p>0.05$) between the two groups (groups 1 & 2) in pH values measured before haemodialysis.

Figure 7 shows the results of SBE measurements. There are means ($\overline{X}$) of SBE measured before (A) and after haemodialysis (B) in patients with interdialysis weight gain (liquid) less than 5% (1) and greater than 5% (2). Statistic analysis by means of "difference method" showed that there was a high statistically significant difference ($p<0.01$) in SBE before and after haemodialysis in both tested groups. It was found that there was no statistically significant difference ($p>0.05$) between the two groups (groups 1 & 2) in SBE values measured before haemodialysis.

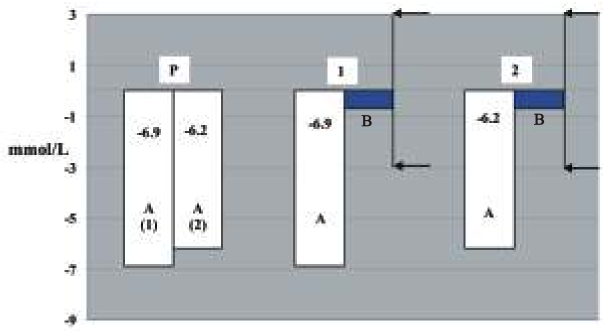

Figure 7. Influence of haemodialysis on SBE values
P. relation between SBE values measured before haemodialysis in groups 1 & 2 patients
1. patients with interdialysis weight gain (liquid) < 5%
2. patients with interdialysis weight gain (liquid) > 5%
A SBE means before haemodialysis
B SBE means after haemodialysis
← Normal values of SBE

Figure 8 shows the results of HCO^-_3 values. There are means ($\overline{X}$) of HCO^-_3 measured before (A) and after haemodialysis (B) in patients with interdialysis weight gain (liquid) less than 5% (1) and greater than 5% (2). Statistic analysis by means of "difference method" showed that there was a very high statistically significant difference ($p < 0.01$) in HCO^-_3 values before and after haemodialysis in both tested groups. There was no statistically significant difference ($p > 0.05$) in HCO^-_3 values in the examined groups (groups 1 & 2).

DISCUSSION

During the research, we observed the parameters of ventilating function: VC, FVC, FEV_1 and SRtot.

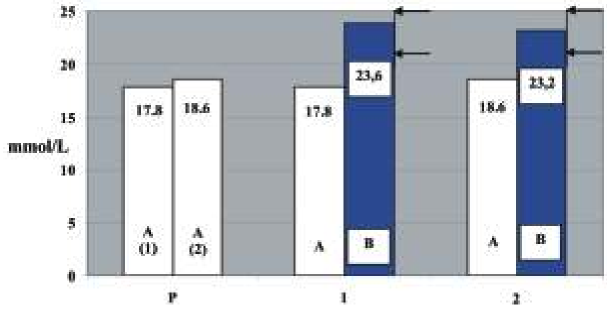

Figure 8. Influence of haemodialysis on HCO^-_3 values
P. relation between HCO_3 values measured before haemodialysis in groups 1 & 2 patients
1. patients with interdialysis weight gain (liquid) < 5%
2. patients with interdialysis weight gain (liquid) > 5%
A HCO^-_3 means before haemodialysis
B HCO^-_3 means after haemodialysis
← Normal values of HCO^-_3

VC, after haemodialysis, shows a change toward recovery, which is statistically of high significance ($p<0.01$). Such a result was found in both groups of tested patients (group 1 and 2). Recovery was more conspicuous in patients with lower interdialysis liquid intake (group 1) and in those patients haemodialysis improved the VC value up to normal values. The obtained results are in compliance with the results obtained by other authors that observed the stated parameter (3 – 5, 8, 12). One of the reasons for VC reduction could be the accumulation of oedematous liquid in the lungs of patients in end-stage renal failure who were treated with repeated haemodialyses (uraemic lung). The exact reason for accumulation of liquid in the lungs of these patients has not been completely known yet (6). Liquid accumulation close to airways leads to their obstruction and disfunction. Haemodialysis removes the excess liquid and increases ventilation of basal lungs areas, and a positive effect is seen in reducing airways obstruction. These events are the reasons for VC recovery. VC values obtained before haemodialysis in patients with lower interdialysis intake (group 1) are statistically lower ($p < 0.05$) compared to the observed values in patients with greater interdialysis intake (group 2). The reason for such results could be the difference in haemodialysis duration, sex, age, and some other antropometric parameters (height and weight) that influence vital capacity values.

FVC, dynamic component of spirometry, shows a tendency for recovery in both observed groups (group 1 and 2), but is of no statistical significance ($p>0.05$). Decrease of FVC values primarily occurs in restrictive diseases, but could be found in manifest congestive diseases (pulmonary oedema). In obstructive diseases (e.g. uraemic lung), FVC values are below VC ones, because, during the forced expiration, intrapleural pressure increases which induces small airways to collapse. Moreover, respiratory muscle force has a great impact on FVC values, which is reduced in patients after haemodialysis. Liquid reduction in the body, as the result of haemodialysis, would decrease the pressure on airways, and reduce obstruction (10–13). These pathophysiological phenomena may be the reason for FCV values recovery. Therefore, the difference between FVC and VC is in favour of obstruction presence and slower recovery of airways in patients with greater interdialysis liquid gain. Comparing posthaemodialysis values of these parameters with normal values, it could be observed that recovery was better in patients with lower interdialysis liquid intake (group 1). FVC values obtained before haemodialysis in patients with lower interdialysis intake (group 1) are statistically lower ($p < 0.05$) compared to the stated values in patients with greater interdialysis intake (group 2). The reason for such results could be the difference in haemodialysis duration, sex, age, and some other antropometric parameters (height and weight) that influence FVC values.

FEV_1. In group 1, after haemodialysis, FEV_1 value is highly improved from the statistic point of view ($p<0.01$), while in group 2 (with greater interdialysis gain) FEV_1 is recovered, but with statistical insignificance ($p>0.05$). Results of other studies conducted on patients suffering from uraemia, show significant FEV_1 recovery after haemodialysis, which matches our results (12,13). Positive effect of haemodialysis on FEV_1 values is more expressed in group 1 (patients with interdialysis liquid gain < 5%) than the patients in group 2 (those with interdialysis liquid gain > 5%). The reason for such results is, very likely, the fact that the patients with less interdialysis liquid gain have lower obstruction degree and impairment of small airways. Greater interdialysis gain in group 2 patients could be the reason for the change in FEV_1 values after haemodialysis not to be statistically significant. These facts show that the patients with interdialysis liquid gain > 5% have greater airways obstruction and consequently slower recovery. Normal values of the observed parameter were not noticed in any of the examined groups, however, recovery was more obvious in patients with lower interdialysis liquid intake (group 1). FEV_1 values obtained before haemodialysis in patients with lower interdialysis intake (group 1) are statistically lower ($p < 0.05$) compared to the stated values in patients with greater interdialysis intake (group 2). The reason for such results could be the difference in haemodialysis duration, sex, age, and some other antropometric parameters (height and weight) that influence FEV_1.

SRtot is a specific resistance in the respiratory trunk. In order to have better observation of changes, the total resistance of airway is corrected for forced residual capacity value (or ITGV) and this is how SRtot is obtained. Increase of resistance in airways may be caused by numerous diseases in the bronchus and lungs, that lead to disorders in bronchial trunk geometry and reduce bronchial volume. References state that after haemodialysis there is a decrease of all resistances in airways in patients suffering from end-stage renal failure (7,12,13). There is no statistically significant change in resistance in airways ($p>0.05$) in any patient after haemodialysis. SRtot values are oriented toward decrease, after haemodialysis in group 1, while this is not the case with group 2 (patients with interdialysis liquid gain > 5 %). Observation of postdialysis SRtot values compared to the normal values of this parameter, suggests the conclusion that decrease in resistance is more expressed in patients with lower interdialysis liquid intake (group 1), than in group 2 patients. Hypoxia and decrease of pO_2 lead to bronchoconstriction, so this is a condition that increases resistance in airways. During and immediately after haemodialysis, hypoxia is registered in our patients. Consequential bronchoconstriction cancelled the positive effect of oedematous liquid removal from the lungs. Lack of statistically significant change of pulmonary resistance parameters after haemodialysis, may be attributed to the abovementioned complex pathophysiological mechanism. Next to hypoxia and bronchoconstriction, greater interdialysis liquid gain may also be responsible for SRtot increase in group 2 after haemodialysis, and thus greater obstruction and slower recovery of small airways. SRtot values obtained before haemodialysis in patients with lower interdialysis intake (group 1) are statistically lower ($p < 0.05$) compared to the stated values in patients with greater interdialysis intake (group 2). The reason for such results could be the difference in heamodialysis duration, sex, age, and some other antropometric parameters (height and weight) that influence SRtot values.

Apart from the ventilating function parameters, acid-base balance indicators have also been observed before and after haemodialysis. The following parameters have been observed: pO_2, PH, SBE and HCO^-_3.

Diffusion of some gas is proportional to pressure caused by that gas. This gas is called partial pressure. Arterial pO_2 is an indicator for oxygen intake into lungs (14). During and after haemodialysis, hypoxia is a documented phenomenon and studied by many authors (15–18). Reasons for hypoxia are the decrease of 2,3 BPG in tissues and consequent diversion of oxyhaemoglobin curve to left. In such circumstances, haemoglobin releases less oxygen into tissues. Apart from decrease of 2,3 BPG, a contact between blood and dialyser causes transient hypoxia, because mechanic stress damages erythrocytes while in contact with dialyser and this leads to the loss of 2,3 diphosphoglicerate. In our study, there was tendency of decrease of arterial pO_2 among all tested groups of patients after haemodialysis, but it was not statistically significant ($p>0.05$). The presence of hypoxia even after the performed haemodialysis confirms the fact that posthaemodialysis values of pO_2 are below normal values for the mentioned parameter. It has been found that there was no statistically significant difference ($p > 0.05$) between the two groups (groups 1 & 2) in the values of pO_2 measured before haemodialysis.

pH is a negative logarhythm of hydrogen ion concentration in a solution, determining its acidity or alkalinity. Acidosis (decrease in pH value) is present in patients suffering from end-stage chronic renal failure. During haemodialysis, acetates or bicarbonates are used as an obligatory therapeutic procedure for correcting acidosis. Therefore, in all tested patients, after haemodialysis, pH increases ($p<0.01$). Postdialysis values of pH are normal in both groups of patients (groups 1 & 2). It has been found that there was no statistically significant difference ($p > 0.05$) between the two groups (groups 1 & 2) in pH values. The results obtained are as expected and they are the outcome of the therapeutic procedure.

SBE is *in vivo* alkaline excess expression, and HCO_3^- are bicarbonate concentration (hydrogen carbonate) in plasma of *in vitro* sample (14,17). In all our patients, SBE and HCO_3^- are highly statistically changed ($p<0.01$) after haemodialysis. Metabolic acidosis is a pathological condition that always occurs with uraemia. Dialysis liquid that corrects pathologically changed body fluid contains bicarbonate or acetate, scientifically called bicarbonate or acetate module. By active influence on metabolic acidosis, modules also change concentration of SBE and HCO_3^- (17). Postdialysis values of SBE and HCO_3^- are normal in both groups of patients (groups 1 & 2). It has been found that there was no statistically significant difference ($p > 0.05$) between the two groups (groups 1 & 2) in SBE and HCO_3^- values. The results obtained are as expected and they are the outcome of the therapeutic procedure.

CONCLUSION

1. Haemodialysis has a positive effect on ventilating function in patients with end-stage chronic renal failure
2. Insufficient recovery of some ventilating function parameters in all tested patients, after haemodialysis, indicates the impairment of obstructive type, with disfunction of small airways.
3. Patients who on haemodialysis with interdialysis body liquids gain above 5% have slower recovery of ventilating functions.
4. Different values of interdialysis liquid gain had no effects on haemodialysis with regard to gas analysis and blood acid-base balance parameters.
5. In all the patients, a tendency of decrease of arterial pO_2 was observed, which is a consequence of the haemodialysis procedure itself.
6. Parameters of acid-base balance of pH, SBE and HCO_3^- cannot be the indicators of tissue respiration, as a respiratory function phase, in patients who were treated with repeated haemodialyses. The reason lies in the use of acetate and bicarbonate module that actively corrected these parameters.

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EFEKTI HEMODIJALIZE NA RESPIRATORNE FUNKCIJE

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SA@ETAK

Hroni~na bubre`na insuficijencija je progresivno i ireverzibilno o{te}enje bubre`ne funkcije. Takvo stanje remeti funkcije gotovo svih organa i organskih sistema, pa tako i plu}a. Kod ovih bolesnika se, u terminalnom stadijumu bolesti, razvija poseban oblik edema plu}a nazvan “uremijsko plu}e”.

Cilj rada je bio da se poka`e efekat hemodijalize i interdijaliznog donosa tjelesne te`ine (vode) na ventilatornu funkciju plu}a.

U radu su testirana 32 bolesnika sa hroni~nom bubre`nom insuficijencijom koji su lije~eni ponavljanim hemodijalizama. Bolesnici su podijeljeni u dvije grupe: grupa 1 ‡ bolesnici sa interdijaliti~kim donosom te~nosti < 5% i grupa 2 - bolesnici sa interdijaliti~kim donosom te~nosti > 5%. Svim bolesnicima je ra|ena tjelesna pletizmografija i gasne analize prije i poslije hemodijalize.

Rezultati do kojih smo do{li ukazuju da hemodijaliza uzrokuje popravljanje vrijednosti ventilatornih parametara VC, FVC, FEV_1. Dinamika oporavaka navedenih parametara ventilatorne funkcije kod na{ih bolesnika, nakon hemodijalize, ukazuje na poreme}aj opstruktivnog tipa, sa disfunkcijom malih disajnih puteva. Bolesnici sa ve}im interdijaliti~kim donosom te~nosti imaju izra`enije promjene u ventilatornoj funkciji (FEV_1) i slabiji oporavak nakon hemodijalize.

Razli~ite vrijednosti interdijaliti~kog donosa te~nosti nisu imale uticaja na efekte hemodijalize na parametre gasnih analiza i acidobaznog statusa krvi.

Iz dobijenih rezultata mo`e se izvu}i zalju~ak da hemodijaliza ima pozitivan efekat na ventilatornu funkciju plu}a, ali slabiji kod bolesnika sa ve}im interdijaliti~kim donosom tjelesne te`ine (vode). Vrijednosti parametara gasnih analiza i acidobaznog statusa krvi ne daju uvid u efikasnost hemodijalize.

Klju~ne re~i: hroni~na bubre`na insuficijencija, hemodijaliza, respiratorna funkcija