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Dialyzate bacteriological quality in a health district

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SUMMARY

Background: *There is a serious lack of data in literature on the quality of dialysate used in haemodialysis units throughout Spain and there also exist discrepancies between clinical guides on criteria related to dialysate bacteriological quality.*

Aim: *Ascertain bacteriological quality of dialysate used in our area.*

Materials & methods: *Descriptive observational studies were carried out monthly and over a period of one year, at two haemodialysis units (unit A: third level public hospital using Monitral®-Hospal monitors and unit B: state subsidised non-profit organisation using AK90®-Gambro monitors. Tests were performed to determine cultures and endotoxins in water treated with reverse osmosis and in the dialysate. Results are expressed as means (range) and as percentage samples that comply with or deviate from the 2004 recommendations of the Association for Advancement of Medical Instrumentation.*

Results: *Cultures showed 7 (0-53), 100% < 200, and 5 (0-50), 100% < 200, cfu./ml in water treated with reverse osmosis and values of 226 (0-1000), 58% < 200, and 75 (0-800), 92% < 200, cfu./ml, were obtained in dialysate from units A and B, respectively. Endotoxins levels were 0,07 (0,05-0,15), 100% < 0,25, and 0.34 (0.06-1.16), 70% < 0.25, UE/ml in water treated with reverse osmosis and 725.72 (1.83-2,645), 90% > 2 and 16 (0.05-60.87), 70% > 2, UE/ml in dialysate from units A and B, respectively.*

Conclusions: *Water treated with reverse osmosis at both units shows good compliance of bacteriological criteria and an acceptable level of endotoxins. The dialysate shows good compliance of bacteriological criteria at unit B and inadequate compliance for unit A. Poor compliance of endotoxins criteria was observed especially in the case of unit A. It would be interesting to have published data on endotoxins levels in dialysate from other dialysis units in Spain, to know if it is possible to achieve the bacteriological quality recommended by the guides using the actual HD monitors without filters for the dialysate and to evaluate from the clinical point of view the utility and efficiency of these filters in conventional HD.*

Key words: ***Dialysate. Endotoxins. Haemodialysis.***

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CALIDAD BACTERIOLÓGICA DEL DIALIZADO EN UN ÁREA SANITARIA

RESUMEN

Antecedentes: *Existen discrepancias entre las guías clínicas sobre los criterios de calidad bacteriológica del dializado y no hay datos en la literatura sobre la calidad del dializado utilizado en las unidades de hemodiálisis de nuestro país.*

Objetivo: *conocer la calidad bacteriológica del dializado utilizado en nuestro entorno.*

Material y métodos: *Estudio observacional descriptivo en dos unidades de hemodiálisis (unidad A: hospital público de tercer nivel con monitores Monitral®-Hospal y unidad B: centro concertado de una fundación sin ánimo de lucro con monitores AK90®-Gambro, realizando mensualmente, durante un año, cultivos y determinación de endotoxinas en el agua tratada con ósmosis inversa y en el dializado. Los resultados se expresan como media (rango) y como porcentaje de muestras que cumplen o se desvían de las recomendaciones de la Association for Advancement of Medical Instrumentation (AAMI) de 2004.*

Resultados: *Los cultivos mostraron 7 (0-53), 100% < 200, y 5 (0-50), 100% < 200, ufc/ml en el agua con ósmosis inversa y 226 (0-1000), 58% < 200, y 75 (0-800), 92% < 200, ufc /ml, en el dializado de las unidades A y B, respectívamente. Los niveles de endotoxinas fueron 0,07 (0,05-0,15), 100% < 0,25, y 0,34 (0,06-1,16), 70% < 0,25, UE/ml en el agua con ósmosis inversa y 725,72 (1,83-2.645), 90% > 2 y 16 (0,05-60,87), 70% > 2, UE/ml en el dializado de las unidades A y B, respectívamente.*

Conclusiones: *El agua tratada con ósmosis inversa de ambas unidades muestra un buen cumplimiento de los criterios bacteriológicos y aceptable de los criterios sobre nivel de endotoxinas. El dializado muestra un buen cumplimiento de los criterios bacteriológicos en la unidad B e inadecuado en la unidad A y un escaso cumplimiento de los criterios de endotoxinas, sobre todo en la unidad A. Sería de interés disponer de datos publicados sobre el nivel de endotoxinas en el dializado de las unidades de diálisis de nuestro país, conocer si es posible conseguir la calidad bacteriológica recomendada por las guías con los monitores actuales de HD sin utilizar filtros para el dializado y evaluar desde el punto de vista clínico la utilidad y eficiencia de estos filtros en HD convencional.*

Palabras clave: ***Dializado. Endotoxinas. Hemodiálisis.***

INTRODUCTION

Bacteriological purity of the water treated with inverse osmosis (IO) and of the dialyzate is gaining more and more relevance because of the suspicion that contamination may play an important role in the inflammatory state of patients on chronic hemodialysis (HD).[1] Besides, it is well known that dialyzate bacteriological quality usually is worse than that of water purified with IO, a fact that has been traditionally acknowledged in guidelines on quality of these fluids.[2,3]

There are discrepancies on recommendations about criteria on bacteriological quality of IO-treated water: culture < 100 CFU/mL and endotoxins < 0.25 EU/mL in European, Swedish, and Spanish pharmacopoeias and guidelines for clinicians from Germany, Holland, Spain, and culture < 200 CFU/mL and endotoxins < 2 EU/mL in the 2004 North American Association for the Advancement of Medical Instrumentation (AAMI).[3-5]

There are still differences between guidelines regarding required criteria for the dialyzate; thus, the Spanish Pharmacopoeia does not defined any criteria for the dialyzate, and the Swedish Pharmacopoeia, the guidelines for professionals in Germany and Holland, as well as the AAMI-2004[3,5] establish similar criteria than those required for IO-treated water, the expert committee of the European Renal Association —2002 European Dialysis and Transplant

Association— recommends that the dialyzate should ultra-pure[6] and the 2003 Spanish committee indicates that the culture should have less than 1000 CFU/mL, with a tendency to be < 100 CFU/mL and an endotoxin level < 0.5 EU/mL.[4]

To our knowledge, there are no published data on bacteriological purity of the dialyzate at dialysis units from our country. Aiming at knowing the bacteriological quality of the dialyzate in our health care area, we have undertaken the following study.

MATERIAL AND METHODS

This is an observational, cross-sectional study done during 12 months at two HD units from the same health care area, one belonging to a tertiary public hospital (Unit A) and the other one belonging to a non-profit foundation (Unit B), both of them with a similar system for water management by means of inverse osmosis. At the public hospital, Monitral® (Hospal) monitors were used and at the private center AK90® (Gambro) monitors were used. Both units used low-ultrafiltration polyamide dialyzers (Poliflux L®. Gambro). Cultures and endotoxin levels of the IO-treated water and of the dialyzate were monthly analyzed from one HD spot and one monitor at each unit, and the spot and the monitor were changed every month. For IO-treated water, the samples were drawn from the circuit outlets, discarding the two first liters of water, and for the dialyzate, samples were taken from the outlets of the dialyzate circuit by means of a 20-mL syringe, and discarding the first extraction. The samples were collected in sterile containers with hermetic closure; after collection, the cultures were immediately processed and endotoxins were cooled and sent to the reference laboratory.

Bacteriological studies of IO-treated water and of the dialysis fluid were done by culturing in soya tripticase agar media at 20º C for 5 days, and endotoxin determination was done by a quantitative photometric LAL (Limulus Amebocyte Lysate) method in aqueous media (Chisvert Laboratories, Alcalá de Henares; Spain) the first two months and by a quantitative kinetic chromogen LAL method (K-QCL) (Echevarne Laboratories; Oviedo; Spain) the remaining 10 months, at the same laboratories for both units studied.

The endotoxin results of the first two months were not taken into account since retrospectively the method used during that period was not considered accurate enough.

The results for the 12 months of culture analysis and the last 10 months of endotoxin analysis are shown as mean and range —considering negative culture as 0— and as percentage of the samples meeting the criteria or diverging from the AAMI 2004 recommendations, used as the reference since the UNE 111-301-90 Rule of the technical committee of AENOR[2] (the Spanish Administration assessing quality) was based on these guidelines and because of being less stringent than European regulations we felt that meeting with the standards would be easier.

RESULTS

Cultures of IO-treated water showed: 7 (0-53), 100% < 200, and 5 (0-50), 100% < 200 CFU/mL at units A and B, respectively, and for the dialyzate they were: 226 (0-1000), 58% < 200, and 75 (0-800), 92% < 200 CFU/mL, at units A and B, respectively (Table I). Endotoxin levels of IO-treated water were: 0.07 (0.05-0.15), 100% < 0.25, and 0.34 (0.06-1,16), 70% < 0.25, EU/mL at units A and B, respectively, and in the dialyzate: 725.72 (1,83-2.645), 90% > 2, and 16 (0.05-60.87), 70% > 2, EU/mL at units A and B, respectively (Table II).

DISCUSSION

At both units we observed an increase in endotoxin levels in the dialyzate after preparation by the HD monitor, which has already been described,[7] and higher bacterial contamination, higher for Unit A with Monitral® monitors in spite of following a cleansing protocol with disinfectants after each HD session and the instructions provided by the manufacturer. This likely due to monitor contamination with

Table I. Cultures of inverse osmosis-treated water and of the dialyzate (CFU/mL)

Month	Unit A: Monitral		Unit B: AK90	
	IO Water	Dialyzate	IO Water	Dialyzate
1	N	200	N	N
2	N	180	N	N
3	N	72	N	N
4	N	120	N	N
5	12	400	8	100
6	N	200	50	800
7	N	N	N	N
8	N	200	N	N
9	N	140	N	N
10	20	1,000	N	N
11	N	100	N	N
12	53	100	N	N
Mean	7	226	5	75

CFU/mL: colonies forming units / milliliter. N: Negative.

Table II. Endotoxin levels in inverse osmosis-treated water and of the dialyzate (EU/mL)

Month	Unit A: Monitral		Unit B: AK90	
	IO Water	Dialyzate	IO Water	Dialyzate
3	0.11	2,645	1.16	26.16
4	0.15	7.07	1.03	4.57
5	0.06	741.50	0.32	40.73
6	< 0.05	74.33	0.14	60.87
7	< 0.05	2.67	0.10	19.84
8	< 0.05	-	0.21	0.13
9	0.06	1.83	0.08	0.66
10	< 0.05	66.12	0.23	3.05
11	0.07	2,002	0.06	< 0.05
12	0.05	1,018	0.11	3.96
Mean	0.07	725.72	0.34	16

EU/mL: endotoxin units / milliliter.

a biofilm in difficult to clean areas by the mixture of non-sterile products (the dialysis concentrate and bicarbonate) with IO-treated water, a phenomenon that would be greater with Monitral® monitors because of their mechanism of ultrafiltration controlled by a dialyzate recirculation chamber.

These high endotoxin levels and the moderate bacterial contamination —although not accompanied by detectable clinical implications in the intermediate term, likely due to the barrier properties against endotoxins of the dialyzer used[8]— indicate that Disinfection measures and dialysis monitors surveillance should be overdone, and that the goals established in the guidelines for dialysis fluid possibly are too ambitious when using HD monitors lacking a dialyzate filter.

The recommendations set in the UNE 111-301-90 Regulation on water for HD used until recent times as the reference in our country[2] did not considered endotoxin levels in IO-treated water for dialysis or the dialyzate. This is the likely reason for not routinely performing endotoxin determinations in the dialyzate for conventional dialysis, at least in Galicia, although this practice is starting to generalize usually by means of qualitative or semi-quantitative techniques (in a recent survey among public hemodialysis units from our community, we were able to confirm that at least 30% of the units performed routine analysis of dialysis fluid).

We therefore do not know the endotoxin level of the dialyzate at our dialysis units and we have not found publications on these levels in Spain either, but yes in other countries.[9] We do not know either whether with the monitors usually used of HD would it be possible to achieve the bacteriological quality of the dialyzate indicated in the guidelines without using specific filters; in the above-mentioned questionnaire, endotoxin levels of the dialyzate were well above of the guidelines recommendations.

On the other hand, there is controversy on what it the optimal level of bacteriological quality for the dialyzate with conventional HD,[10,11] and there are not conclusive studies on this issue[12] since we have to bear in mind that current guidelines are based on a C-level evidence.

To conclude, we should carry out additional studies, in the first place to gain more insight on the bacteriological quality of the dialyzate at our units and of its possible clinical implications in the intermediate and long terms; in the second place, to know whether with usually used HD monitors is it possible to achieve the endotoxin level and the CFU/mL value of the dialysis fluid recommended in clinical guidelines, or whether would it be necessary to use dialyzate filters to meet with them; and in the third place, to know the usefulness and efficiency of such filters before recommending their widespread use since there exist controversial data on their clinical efficacy for conventional HD.[8,13]

Finally, we would like to comment on the semi-quantitative method for determining endotoxins (the quantitative photometric LAL method in aqueous media) used for the first two months of our study, which was considered little reliable since it always showed endotoxin levels lower than 0.03 EU/mL, for both IO-treated water and the dialyzate, values which were highly different form those obtained with the reference quantitative method, and with no variations with water treatments or water circuit and monitors cleansing and disinfection protocols. Thus, based on our experience, we believe as very important to check the reliability of the method used for endotoxins determination.

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