

Reuse of Different Types of Dialyzers: First Longterm Results in Turkey

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Introduction

Dialyzer reuse which means using the same dialyzer for the same patient more than once was first performed in 1964 by Shaldon et al (1) and its usage is becoming increasingly frequent in many countries, especially the USA (2). Table 1 shows the list of countries where reuse is performed and their overall percentages of reuse. As can be seen from this table, reuse is performed in many parts of the world regardless a country is wealthy or in economic difficulties. Hence, it is somewhat surprising that dialyzer reuse is practically non existent in the Balkan countries and Turkey.

Table 1: Percentage of hemodialysis centers in different countries reusing dialyzers and percentage of centers using automated reprocessing.(17,21)

COUNTRY	%REUSE	%AUTOMATED
SINGAPORE	>95%	>95%
MALAYSIA	>95%	30%
CHINA	>95%	25%
HONG KONG	>95%	75%
THALIAN	>95%	20%
INDONESIA	>95%	10%
PHILIPPINES	>95%	10%
PAKISTAN	>95%	10%
INDIA	>95%	<5%
POLAND	>95%	50%
SOUTH KOREA	10%	>95%
TAIWAN	30%	>95%
AUSTRALIA	5%	>95%
SWITZERLAND	18%	>95%
ISRAEL	10%	>95%
UNITED KINGDOM	10%	>95%
BELGIUM	20%	>95%
GERMANY	<5%	>95%
RUSSIA	30%	>95%
SAUDI ARABIA	5%	-
TURKEY and BALKAN COUNTRIES	0%	-

In Turkey, the reimbursement of one hemodialysis session costs almost 80 US dollars. The all-inclusive yearly cost of hemodialysis per patient is 22.644 US dollars and the total all-inclusive cost of Renal Replacement therapy for the country is 488.000.000 US dollars. This corresponds to 5 % of the total yearly health expenditure of the country and is certainly not a small sum to pay for a country in economic difficulties. In Turkey, as is the rest of the world the number of ESRD patients is increasing every year, but the budget allocated for ESRD treatment is unable to meet the ever-

increasing demand. We think that the introduction of dialyzer reuse to everyday practice would constitute a sound and logical way of bypassing the above difficulties.

In Turkey, reuse has been practiced on several occasions in the past, but for various reasons these applications remained all short-lived (3, 4, 5). The first long term application of dialyzer reuse in Turkey started in 1999 right after the Marmara Earthquake at Cerrahpaşa Medical Faculty in Istanbul thanks to a second-hand automatic triple reuse machine (Dialurix) sent by Professor N. Lameire as a courtesy gift from the Gent University in Belgium. And first hand computerised reuse machine was procured and dialyzer reuse has been practiced more methodically and without interruption ever since.

This article, reports the summary results of a study done during this practice.

Material and Methods

This study was done between March 2002 and, May 2003 at the reuse room of the Cerrahpaşa Medical Faculty with 19 polysulphon (F5, F6, F7, F8), 5 hemophane and 5 cuprophane membranes used in 29 patients under regular hemodialysis at Cerrahpaşa and Marmara Medical Faculties dialysis centers.

All 29 patients were without social security or private health insurance and had to finance their own dialysis and some had also difficulties in doing that. They all were informed about the reuse procedure and their written consent was obtained. The reuse procedure was performed in a well illuminated special 20 m² room by a dialysis technician using the Renatron II machine and Renaline (paracetic acide, hydrogen peroxide and acetic acid) as sterilizing solution. Both the machine and the sterilizing solution were provided by the Minntech firm, Amsterdam, Holland. Each patient underwent dialysis with minimum blood flow mean 300 ml/min, bicarbonate dialyzat flow of 500 ml/min. Renatron II automated dialyzer reuse system with Renalin sterilant (Minntech BV-Amsterdam, Holland) was used for sterilization of dialyzer. The whole process of preparation of a dialyzer for reuse took 30 minutes and included initial high pressure check for any fiber break followed by measurement of fiber volume. If fiber volume was more than 80 % dialyzer would be passed by the computer for reuse processing. Sterilization by Renalin was then done and the dialyzer labeled and stored for more 36 hours before the next session(at room temperature) (AAMI, 6). Each dialyzer was

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cross checked by the technician for correct labeling before initiation of hemodialysis. Rinsing of the dialyzers was as usual before connecting the patients. Residual sterilant level were checked using to agent strip before initiation of dialysis. Dialyzer from the end of the treatment day were refrigerated overnight for reprocessing in the morning. Patients with Hepatitis B or C were kept out of the reuse procedure. The number of reuses per patient varied between 5 and 15.

At the 5th, 10th and 15th days of the reuse procedure. Reused dialyzers were checked for ultrafiltration (UF), fiber bundle volume (FBV) and the respective patients for dialysis efficiency (KT/V) and serum total protein and albumin levels. Beta-2 microglobulin and cytokine levels were not included in the study. Results of these laboratory investigations are presented in Table 2.

Table 2: Some laboratory data of reused patients group.

Dialyzer	Number of Reuse	Kt/V(mean)	FBV	Ultra-filtration (ml)	Serum albumin (mg/dl)
Polysulfone F5(n=2)	1.Reuse	1,36±0,02	58	2300	3,80±0,01
	5.Reuse	1,39±0,01	57	2250	3,75±0,02
F6(n=4)	1.Reuse	1,19±0,20	87,33	1760	3,90±0,28
	5.Reuse	1,16±0,29	85	1930	3,86±0,20
	10.Reuse	1,58±0,02	77	1900	3,91±0,01
	15.Reuse	1,46±0,01	78	1550	3,80±0,21
F7(n=6)	1.Reuse	1,31±0,20	105	2560	3,95±0,19
	5.Reuse	1,47±0,34	102	2550	3,98±0,25
	10.Reuse	1,60±0,01	90	3000	3,92±0,32
F8(n=7)	1.Reuse	1,53±0,29	101	2485	
	5.Reuse	1,28±0,33	99,5	2828	
	10.Reuse	1,47±0,26	96,8	2000	
Cuprophane (n=5)	5.Reuse	1,22±			
Hemophane (n=5)	1.Reuse	1,28±			
	5.Reuse	1,11±			

At present in our country, 3.240.000 dialyzers that are all imported are used and thrown away in one year. The cost of a single dialyzer varies between 13 and 17 euros depending on their membrane types and the average cost has been taken as 15 euros. The (amortisman) of the reuse machine and the computer, the electricity cost, the technician’s salary and the costs of cleaning solutions, sterilizing solutions, reverse osmos fluid, heparine and test strips were included into the cost of reuse procedure. The total cost per reuse procedure was found to be about 5.7 euros. The cost per dialyzer with 5 reuses is about 7.4 euros, with 10 reuses is about 5.4 euros and 20 reuses is about 4.4 euros.

In patients whose dialyzer were reused there were no significant differences between the initial values and the 5th, 10th, 15th and 20th reuse values for UF, FBV, serum protein and albumin. The Kt/V however was found to increase with increasing reuse numbers (Table 2). But this increasing is not significant.

Discussion

In USA, the fixed prices applied to dialysis reimbursement starting from 1982 has lead to an increase of the practice of

dialyzer reuse throughout the country. This brought about research on membrane biocompatibility (7), intra-treatment complications (8) and later on the survival of patients subjected to dialyzer reuse (9, 10). Also the effects of the remnants in the dialyzer of the sterilizing substance used on the patient and the technician were subject to debate (9). The sterilizing solution used in our study is at present utilised in USA at a rate of 56 % (9). In our 29 patients, throughout the reuse period of 14 months there were no pyrogenic, toxic or cardiovascular side effects during or following dialysis and no change in their biochemistry was encountered. Also, the sterilizing solution used did not have any harmful effect to the dialysis technician throughout its continuous use.

The relatively higher mortality rates in USA compared to Europe and Japan were scrutinised. No difference of dialysis mortality was found between patients subjected to dialyzer reuse and those who were not (9,10,11) and dialysis mortality in USA declined while the practice of reuse continued its spread. Higher dialysis mortality rates in USA were rather found to be related to co-morbid factors such as anemia (epo was not reimbursed in USA until 1990), under nutrition and short dialysis duration (12).

Also in USA, the DMMS morbidity-mortality study done in 20000 patients did not reveal any difference between patients subjected and not subjected to dialyzer reuse especially when a proper sterilizing solution was used (12). The same study pointed also to an insignificant increasing of Kt/V values in patients subjected to reuse which seems to be the case in our patients as well. A patient who is hemodialyzed for five years is exposed to foreign material (dialyzer membrane) as large as a football field (10 000-11 000 m²). The resulting activation of complement and proinflammatory cytokines leads to reactions such as pruritus and hypotension in short term and chronic inflammation and perhaps atherosclerosis in the long-term. While the well documented clinical benefits of dialyzer reuse with cellulose membranes (elimination of first use syndrome, improved biocompatibility) have become of secondary importance on dialysis atherosclerosis (7). In one of our patient suffering from chronic pruritus dialyzer reuse has resulted in a substantial improvement of this complaint. In another patient, dialyzer reuse was associated with an emotional improvement and a sense of well-being.

In patients subjected to reuse Changes in small (urea, creatinine) and middle molecular (beta-2 microglobulin) substrates clearances were also investigated. We didn't check the beta-2 microglobulin levels. Some studies reported changes in beta-2 microglobulin large solute clearances following ten or more reuses (13,14). In our patients there were no changes between the urea and creatinine levels of those subjected and not subjected to dialyzer reuse. Previous studies from our country have shown that reuse ameliorates oxidative stress and has an enhancing effect on the plasma antioxidative mechanism (7, 8). There were no one with hepatitis in our patient group. But studies that were carried out on this subject have revealed that no contamination from patients with hepatitis to the others and that, on the contrary the cleansing and sterilization, which are part of the reuse practice induce inactivation of hepatitis and HIV viruses (15). These articles state that there is no need for separate dialysis machines or room for patients with hepatitis. For a reuse of 10 times the profit procession is 9.6 euros. For each ten additional reuses the dialyzer cost is reduced an additional 50 %. In short if each dialyzer were to be reused ten times the potential profit for the country would amount to about 30.000.000 euros per year. As for the savings brought about by the regular practice of reuse it has been calculated that in USA a high quality dialyzer that costs 30 US dollars comes to 14 US dollars with seven reuses and to 7 US dollars with 18 reuses. Thus, the saving from 1400 reused dialyzers amounts to 10000 US dollars (16). In Sheffield, UK the yearly saving from 400 patients subjected to regular dialyzer reuse amounts to 250.000 British pounds (17). From the Western Hospital in Toronto, Canada it was reported that no difference of morbidity and mortality was found between patients subjected to reuse and those who were not and that the yearly savings due to regular reuse practice amounted to 309.000 Canadian dollars (18).

In USA and Europe there are no regulations on reuse except the technical guidelines issued by scientific bodies interested in the field. The AAMI standards (6) from USA to which we are also adhering are accepted throughout the world. The major difficulty we face in Turkey is that most patients who are under social security and health insurance coverage get a reimbursement based on single use of a dialyzer. Moreover, dialyzers with labels "suitable for reuse" (which are not any different from those without the label) are not imported to the country. In USA it is largely agreed that reuse is a practice based on the physician's will and decision and that should be there is no need for the patient's consent (10). But, there are those who feel that the patient should be at least informed beforehand (19). Both in USA and England dialysis centers who practice reuse and those who don't are reimbursed similarly (20,21). This allows the coverage of reuse costs, a substantial reduction in the numbers of dialyzers used (and for Turkey imported) and hence of waste material. Moreover, this way deficient reimbursements that may not cover new or unforeseen cost increases also are indirectly compensated.

Conclusion

Hemodialysis remains an expensive treatment. The practice of reuse reduces the costs and allows an increase in the use of the expensive but highly biocompatible membranes. Apart from savings, reuse has also beneficial effects on patients (a decrease in first use symptoms, pruritus, hypotension and in the long term perhaps a protective effect on the development of atherosclerosis) and on environmental protection.

It is a method highly advisable for use especially in countries with economic difficulties.

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