

# EVALUATION OF THE CURRENT STATUS OF HOME HEMODIALYSIS IN THE MIDDLE EAST THEN PERSPECTIVES AND POSSIBILITIES OF HOME HEMODIALYSIS IN EGYPT

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## Abstract

**Aim of the Work:** The purpose of this study was to assess the state of home hemodialysis in the Middle East at the moment. **Patients and Methods:** There were two sections to it: a prospective and a retrospective. The study comprised 131 patients who were either kept on home hemodialysis from March 2019 to March 2020 or had been maintained on home hemodialysis for the previous five years. Saudi German Hospital, Erfan Hospital, GNP Hospital, and King Fahd Military Hospital were in charge of those patients. They were all in Saudi Arabia, in Jeddah. **Results:** Most patients had poor mean urea reduction ratios (URR %), particularly those from the retrospective group (56% versus 63%). The mean KT/V was 1.1 as opposed to 1.18. At 36%, the first-year mortality rate was noticeably high for all patients. On the other hand, it was much greater (40.7% versus 28%) in patients in the retrospective portion. Positive or negative correlations were found for some of the mortality predictors. **Conclusion:** In the Middle East, home HD was only selected to treat a severely compromised subset of end-stage renal disease (ESRD) patients who met strict criteria, such as being bedridden, wheelchair-bound, mentally ill, or experiencing cerebrovascular accidents (CVAs), amputations, non-union fractures, or severe difficulties accessing in-center hemodialysis. There are less reported intra-dialytic consequences in this benign form of HD. When combined with home HD, patients with volume overload or cardio-renal syndrome were better able to tolerate excessive ultrafiltration (UF). In newly diagnosed HD patients, the loss of residual renal functions was notably minimal. In addition to using ultrapure dialysate, these advantages were associated with reduced dialysate exposure. However, if Home HD is done three times a week, it becomes ineffective for the majority of patients. Finally, there is an additional expense as a result of high staff and supply costs.

**Keywords:** Home Hemodialysis, Middle East, Egypt.

## BACKGROUND

Comparing home hemodialysis (HD) to traditional hemodialysis, there are a number of advantages. A better quality of life, more time freedom, lower costs, and better patient outcomes are a few of them. Increasing the frequency or intensity of home hemodialysis can lead to better patient outcomes in terms of mortality, blood pressure control, left ventricular geometry, phosphate control and mineral metabolism, sleep quality, and fertility. After treatment, people receiving dialysis at home usually recover in approximately half the time of those receiving it in a centre.

Due to decreased personnel expenses, probable pharmaceutical costs, and potential improvements in renal disease-related quality of life and survival, home hemodialysis is economical or cost-saving [1-3].

For patients with end-stage renal disease (ESRD), intensive home hemodialysis (IHHD) has become a viable alternative therapy option. It offers a number of established and possible clinical advantages.

These therapeutic benefits must be balanced against the increasing awareness of the dangers associated with IHHD, which may include an increased requirement for vascular access procedures. The growth of infusion-hemodialysis (IHHD) as a significant kind of renal replacement therapy depends critically on determining who would be an eligible and ideal candidate [4].

Sadly, very few ESRD patients in the Middle East receive HD because there are numerous major obstacles to receiving hemodialysis in-center. Lately, these nations have seen some availability of the NxStage portable hemodialysis machine, which is frequently utilised to manage home hemodialysis for ESRD patients who are not as rigorously screened. Nevertheless, statistical information regarding this initiative is still scarce [5, 6].

## **PATIENTS AND METHODS**

There were two parts to the study: a retrospective and a prospective one. Eighty ESRD patients who had received treatment and were kept on HD for the previous five years made up the first study section.

A prospective study of fifty-one new ESRD patients who received treatment and were kept on HD for a year made up the second research section. The research was conducted in 2020 and 2019. Saudi German Hospital, Erfan Hospital, GNP Hospital, and King Fahd Military Hospital were in charge of those patients. They were all in Saudi Arabia, in Jeddah.

### **Inclusion criteria**

Adult patients with end-stage renal disease (ESRD) who are older than 18 years old were treated and kept on HD either for the previous five years or from March 2019 to March 2020.

### **Exclusion criteria**

ESRD patients who were occasionally treated by HD for several sessions due to certain temporary circumstances and terminally-ill ESRD patients, in whom HD was done as a form of adjuvant palliative therapy.

### **Sample size**

80 patients for the retrospective part and 51 patients for the prospective part.

### **Ethical considerations**

An informed consent was obtained from all patients or their representatives before their data were included in the study.

## Study Tools

The included patients were subjected to

**Clinical data:** Including age, sex, body mass index (BMI), cause of ESRD, comorbidities, psychological status, social support, family history of ESRD, cause of treatment by HD, compliance to HD, previous treatments of ESRD, used vascular access and virology status.

**Laboratory data:** include averages for the following: total iron binding capacity (TIBC), iron saturation, ferritin, C-reactive protein (CRP), haemoglobin, hematocrit, calcium, phosphorus, albumin, parathyroid hormone (PTH), white cell count (WCC), platelet counts, and serum iron.

## Hemodialysis treatment parameters

Including frequency of sessions, duration of each session, Dialysate Flow Rate, Blood Flow Rate, Ultrafiltration Rate, Urea Reduction Ratio (URR) and KT/V [7-10].

## Measures of clinical outcome

Details of all patient charts and data were thoroughly analyzed for the purpose of overall evaluation of home hemodialysis in ESRD patients in the region of Middle East.

**Primary outcome:** Mortality statistics in ESRD patients maintained on home hemodialysis.

**Secondary outcome:** Frequency of hospitalization, family satisfaction, total costs and reported intradialytic complications including sudden cardiac death.

## Statistical analysis and package

Data was presented as mean and standard deviation for quantitative parametric data and median and interquartile range for quantitative non-parametric data. Frequency and percentage was used for presenting qualitative data.

Suitable analysis was done according to the type of obtained data. Students T test or Mann Whitney test was used to analyze quantitative data while Chi-square test and Fisher Exact test was used to analyze qualitative data.  $P < 0.05$  was considered to be statistically significant.

## DISCUSSION

Home HD has been started in the Middle East for the last several years. Simple machines were developed only for the purpose of Home HD. The 1st one was the NxStage machine that had been developed in Unites States of America (USA) and was introduced to Kingdome of Saudi Arabia (KSA), United Arab Emirates (UAE) and Qatar, in 2012. The 2nd one was the DIMI machine that had been developed in Switzerland and was approved by the Saudi Food and Drug Administration (FDA), in late 2019.

The mean age of patients in the retrospective study was 68.5, while that in the prospective study was 61.8 years. This age differences were related to an involvement of less elderly and healthier patients in the last few years.

The mean body mass index (BMI) was slightly higher in patients of the prospective part as it was 26.2, while it was 25.7 kg/m<sup>2</sup>, in patients of the retrospective part.

Most ESRD patients have multiple comorbidities that increase with age. IHD was present in 28% of patients of the prospective part while it was 54.9% in patients of the retrospective part [11,12].

Regarding the cause of treatment with home HD, the situation was serious. For patients of the retrospective part, only 23.5% of them were treated as per their personal choice.

**Table 1: Cause of treatment with home hemodialysis in the old group**

Frequency		Percent	Valid Percent	Cumulative Percent
Valid	bed-ridden	15	18.5	18.5
	cerebro-vascular accident	14	17.3	35.8
	Dementia	3	3.7	39.5
	fracture femur	12	14.8	54.3
	Mania	1	1.2	55.5
	Paraplegia	1	1.2	56.7
	personal choice	19	23.5	80.2
	poor compliance	5	6.2	86.4
	Psychosis	1	1.2	87.7
	Peripheral-vascular disease	10	12.3	100.0
	Total	81	100.0	100.0

The remaining was treated due to serious morbidities with frequencies as following: bed-ridden 18.5%, CVA 17.3%, fracture femur 14.8%, PVD 12.3% and others 13.5% (Table 1). For patients of the prospective part, the situation was different as 50% of them were treated as per their personal choice because of the serious world-wide pandemic of Covid-19. The other 50% were treated due to disabling morbidities with frequencies as following: bed-ridden 18%, dementia 12%, fracture femur/tibia 12%, CVA 8% and others 6%

**Table 2: Cause of treatment with home hemodialysis in the new group.**

Frequency		Percent	Valid Percent	Cumulative Percent
Valid	bed-ridden	9	18.0	18.0
	blindness	1	2.0	20.0
	COVID-19 Pandemic	25	50.0	70.0
	cerebro-vascular accident	4	8.0	78.0
	dementia	6	12.0	90.0
	fracture femur	2	4.0	94.0
	fracture tibia	1	2.0	96.0
	Parkinson's disease	1	2.0	98.0
	Peripheral-vascular disease	1	2.0	100.0
	Total	50	100.0	100.0

The frequency of home HD was 13 sessions/month in 59% of all patients. The remaining patients were treated with higher frequencies, mainly with 15 or 17 sessions/month (Tables 3 and 4).

**Table 3: Frequency of sessions/month, in the old group**

Frequency		Percent	Valid Percent	Cumulative Percent
Valid	13/month	54	66.7	66.7
	15/month	5	6.2	72.8
	17/month	19	23.5	96.3
	25/month	2	2.5	98.8
	26/month	1	1.2	100.0
Total	81	100.0	100.0	

**Table 4: Frequency of sessions/month, in the new group**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	13/month	23	46.0	46.0	46.0
	15/month	17	34.0	34.0	80.0
	17/month	9	18.0	18.0	98.0
	21/month	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Most patients reported no complications during their sessions. This was noted in about 86% of all patients. The remaining 14% of patients reported occasional hypotension; hypoxemia, chest pain etc (Tables 5 and 6).

**Table 5: Complications in the old group**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	74	91.4	91.4	91.4
	hypotension	6	7.4	7.4	98.8
	hypoxemia	1	1.2	1.2	100.0
	Total	81	100.0	100.0	

**Table 6: Complications in the new group**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	39	78.0	78.0	78.0
	chest pain	1	2.0	2.0	80.0
	vomiting	1	2.0	2.0	82.0
	hypotension	8	16.0	16.0	98.0
	dialysate reaction	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

**Table 7: 1st year mortality in the old group**

Frequency		Percent	Valid Percent	Cumulative Percent
Valid	Yes	33	40.7	40.7
	No	48	58.3	100.0
	Total	81	100.0	100.0

**Table 8: 1st year mortality in the new group**

Frequency		Percent	Valid Percent	Cumulative Percent
Valid	Yes	14	28.0	28.0
	No	36	72.0	100.0
	Total	50	100.0	100.0

The mean URR% was 56 and 63 for those in the retrospective and prospective parts, respectively. Also, the mean KT/V was 1.1 for patients in the retrospective part and 1.18 for patients in the prospective part.

Regarding the 1st year mortality as the 1-year outcome of the whole study, the results were alarming. It was significantly high in all involved patients, about 36%. It was also significantly higher in patients of the retrospective part as it was 40.7% (Table 7) while it was 28% for those of the prospective part (Table 8). This reported high mortality warrants searching for the possible mortality predictors.

Mortality predictors with a +ve correlation were as following: age, BMI, vascular access (AVF/catheter), virology status (positive /negative), phosphorus, TIBC, CRP, ferritin, frequency of hospitalization and complications (no/yes) (Table 9).

Mortality predictors with a negative correlation were as following: psychological status: depressed/borderline/good, creatinine, albumin, PTH, Hb%, HCT and iron (Table 9).

**Table 9: Efficiency of Home Hemodialysis according to related variables**

		URR %	KT/V
BMI	Pearson Correlation	-.342**	-.396**
	Sig. (2-tailed)	.000	.000
	N	131	131
Vascular access	Pearson Correlation	-.105	-.091
	Sig. (2-tailed)	.234	.302
	N	131	131
Type of machine	Pearson Correlation	-.462**	.427**
	Sig. (2-tailed)	.000	.000
	N	131	131
Frequency/month	Pearson Correlation	-.299**	-.322**
	Sig. (2-tailed)	.001	.000
	N	131	131
Duration	Pearson Correlation	.467**	.389**
	Sig. (2-tailed)	.000	.000
	N	131	131
Complications	Pearson Correlation	-.172*	-.168
	Sig. (2-tailed)	.049	.056
	N	131	131
Frequency numeric	Pearson Correlation	-.309**	-.330**
	Sig. (2-tailed)	.000	.000
	N	131	131

Surprisingly, both URR% and KT/V were insignificantly correlated with 1st year's mortality. However, this is explained by the fact that efficient hemodialysis per isn't enough to improve mortality rates in ESRD patients.

Regarding the frequency of hospitalization, there were many predictors with either a +ve or a -ve correlation of significant values. Most of these predictors were similar to those of the 1st year mortality. Both URR% and KT/V were not significantly correlated with the frequency of hospitalization.

Regarding URR% and KT/V, there were some important predictors with either direct or indirect effects. Of course, DFR, BFR and duration are strongly related. The other predictors were as following and all were of a negative correlation: BMI, type of machine (DIMI/NxStage), frequency of HD and complications. In fact, these 4 predictors needs further discussions and explanations.

For BMI, hemodialysis clearance is negatively correlated. Most home HD patients were of low URR% and KT/V, mainly due to the low DFR as compared with in-center HD patients. So, patients with subnormal BMI may have adequate clearance. However, patients with even normal BMI rather than being overweight will have insufficient clearance. These observations were thoroughly discussed before with all related authorities that there was insufficient hemodialysis for most of these patients. However, this form of HD was found to be the best to offer to some patients who were bed-ridden, very elderly, demented or with non-union fractures. These patients were hardly brought to hospitals to get their regular HD sessions and some of them were left as neglected at home to finally die of uremia.

Regarding the frequency of HD sessions, which is negatively correlated with HD clearance as more frequent HD will decrease the pre-dialysis urea. Furthermore, with more frequent HD, the duration of treatment mostly will be decreased as mainly per the patient's choice.

Regarding the cost of home HD, each session is almost double the cost to that in-center HD. However, it saves the extra cost of transportation especially of bed-ridden patients and avoids the psychological burden of both the patients and their involved care-givers and/or relatives [13, 14].

For possibilities of HD in Egypt, it is so difficult to be managed for the rapidly growing population of hemodialysis patients with the current limited resources. It can be only done for some selected patients who can afford for it.

## CONCLUSION

- Home HD was first decided for only home-bound or bed-ridden elderly patients who are unable to get in-center HD. However, in the last few years, more patients were included in the program of home HD with less strict criteria.
- Home HD with the usual frequency of 3 sessions/week, is an insufficient form of renal replacement therapy for most ESRD patients. It is sufficient in only those patients who are under-weight with subnormal BMI. Those patients with high or even normal BMI, need more frequent and intensive home HD, to get a sufficient HD.
- Home HD, by its current management in the Middle East, is an expensive form of renal replacement therapy. The extra cost is related to expensive supplies and personnel charges.
- Despite home HD is an expensive and less efficient form of renal replacement therapy for ESRD patients, it resolves a great majority of the total burden related to managing a highly compromised group of ESRD patients who are bed-ridden, wheel-chair-bound, demented or having CVA, amputations or non-union fractures ... etc, who have a great difficulty to get HD in centers/hospitals.
- The 1st year mortality was very high in patients of home HD due to the burden of the underlying multiple co-morbidities rather than the insufficient HD. Many mortality predictors were found as age, BMI, CRP, phosphate, PTH, Albumin, Hb%, vascular access, virology status, etc.
- The psychological status was significantly improved in those patients with having their sessions at their homes without any added stressors related to in-center HD. Even new ESRD patients who are too reluctant to start HD, were better convinced to start home HD.
- Home HD is a gentle and benign mode of HD with less reported intra-dialytic complications; attributed to the use of ultrapure dialysate solutions other than the treated tap/well water used in center HD.
- HD patients with volume overload or those with cardio-renal syndrome were found to better tolerate excessive UF with the use of home HD machines than that with the usual in-center machines. SLED and SCUF modes were very effectively managed with the use of these simple HD machines.

- It was noticed that the loss of residual renal functions in new HD patients, was significantly less with the use of home HD than with the usual in-center HD. This was related to less dialysate exposure other than the use of ultrapure dialysate.
- Home HD with the DIMI machine reported more clearance rates than that with the NxStage one, despite the same HD parameters. This was related to certain technical characteristics of the DIMI machine that counts only the effective time of HD and calculation of the required BFR.
- In Egypt, home HD is currently unavailable and hardly applicable in the current state of economic instabilities. It can be applicable for a very small number of patients who can afford for it as the country will not apply it for the general use.

## **Declarations**

### **Ethics approval and consent to participate**

- 1) Ethical approval was obtained from the ethical committee of Ain-Shams Faculty of Medicine before starting the study.
- 2) Approval from the included hospitals administrations were obtained to collect patient data
- 3) Consent to participate was also done by all participating patients/relatives.

### **Consent for publication**

- 1) All patients/relatives signed a consent for publications.
- 2) All authors accept the manuscript for submission and publication.

### **Availability of data and material**

All patient data are available in a large master sheet and it is ready to share at any time.

### **Competing interests**

I confirm that there is no any conflict of interests.

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None. The study was totally done on my own expenses.

### **Authors' contributions**

All authors largely contributed to the study other than being supervisors.

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## **References**

- 1) Barua M, Hladunewich M, Keunen J, Pierratos A, McFarlane P, et al. (2008) Successful pregnancies on nocturnal home hemodialysis. *Clin J Am Soc Nephrol* 3: 392-396.
- 2) Blagg, Kjellstrand CM, Ting GO, Young BA (2006) Comparison of survival between short-daily hemodialysis and conventional hemodialysis using the standardized mortality ratio. *Hemodialysis Int* 10: 371-374.
- 3) Chan CT, Harvey PJ, Picton P, Pierratos A, Miller JA, et al. (2003) Short-term blood pressure, noradrenergic, and vascular effects of nocturnal home hemodialysis. *Hypertension* 42: 925-931.
- 4) Schröder CH (2008) *Comprehensive Pediatric Nephrology*. In: Geary DF, Schaefer F (eds) *Renal Replacement Therapy*. Elsevier Health Sciences, Netherlands.
- 5) Culleton BF, Walsh M, Klarenbach SW, Mortis G, Scott-Douglas N, et al. (2007) Effect of frequent nocturnal hemodialysis vs conventional hemodialysis on left ventricular mass and quality of life: a randomized controlled trial. *JAMA* 298: 1291-1299.

- 6) Hanly PJ, Pierratos A (2001) Improvement of sleep apnea in patients with chronic renal failure who undergo nocturnal hemodialysis. *N Engl J Med* 344: 102-107.
- 7) Garcia-Garcia G, Norris KC, Agodoa L (2017) *Chronic Kidney Disease in Disadvantaged Populations*. Elsevier Science, Netherlands.
- 8) Tennankore K, Nadeau-Fredette AC, Chan CT (2014) Intensified home hemodialysis: clinical benefits, risks and target populations. *Nephrol Dial Transplant* 29: 1342-1349.
- 9) Himmelfarb J, Sayegh MH (2010) *Chronic Kidney Disease, Dialysis, and Transplantation*, 3rd Edition. Elsevier Health Sciences, Netherlands.
- 10) Nissenson AR, Fine RN (2017) *Handbook of Dialysis Therapy*, 5th Edition. Elsevier Health Sciences, Netherlands.
- 11) Van Eps CL, Jeffries JK, Johnson DW, Campbell SB, Isbel NM, et al. (2010) Quality of life and alternate nightly nocturnal home hemodialysis. *Hemodial Int* 14: 29-38.
- 12) Walker R, Marshall MR, Morton RL, McFarlane P, Howard K (2014) The cost-effectiveness of contemporary home haemodialysis modalities compared with facility haemodialysis: a systematic review of full economic evaluations. *Nephrology (Carlton)* 19: 459- 470.
- 13) Walsh M, Manns BJ, Klarenbach D, Tonelli M, Hemmelgarn B, et al. (2010) The effects of nocturnal compared with conventional hemodialysis on mineral metabolism: a randomized-controlled trial. *Hemodial Int* 14: 174-181.
- 14) Weinhandl ED, Liu J, Gilbertson DT, Arneson TJ, Collins AJ (2012) Survival in daily home hemodialysis and matched thrice-weekly in- center hemodialysis patients. *J Am Soc Nephrol* 23: 895-904.