Original Article

Impact of Educational Intervention on Pharmacists' Knowledge Regarding Drugs' Dialyzability

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Abstract

Background: Drug dialyzability is the extent to which a drug is filtered out of the blood throughout dialysis. It is affected by many factors, some are associated with the drug itself, and others are associated with the properties of dialysis procedures. As a drug expert, a pharmacist should make more attention to drugs' dialyzability when counseling medications for a patient to ensure that the drug concentration remains inside patients' body is enough to do its therapeutic effect. **Objective:** The study aims to evaluate and improve the knowledge of pharmacists who were working at dialysis wards regarding drugs' dialyzability. **Materials and Methods:** An educational pre–post interventional study was conducted from November 2022 to February 2023. The target group was the pharmacists who were working in dialysis wards of one of four health institutions in Al-Najaf city, Iraq. The study was based on a questionnaire that contained 31 questions in three sections. To evaluate the impact of an educational intervention. The same questionnaire was distributed to the participant pharmacists before, directly after and after 8 weeks of the intervention. The data were analyzed using SPSS (version 24). **Results:** Out of 36 pharmacists, 32 accepted to enroll in the study. The response rate was 88.8%. All of the participants (100%) were holding bachelor's degrees in pharmaceutical science. Females were the dominant (85%), and the majority (87%) were ≤30 years old. The mean knowledge score of the participants was significantly raised from 44.5% before the intervention to 78.8% after it ($P < 0.001$). Moreover, after 8 weeks from the educational intervention, the knowledge score was only slightly decreased to 74.2%. **Conclusion:** The impact of the educational intervention is obviously touchable, where the knowledge score of the participants was doubled after establishing it. Farther more, this increment in the knowledge remained approximately at the same level even after 2 months of the intervention.

Keywords: Dialyzability, drug, intervention, knowledge, pharmacists

Introduction

Dialysis is a procedure that simulates the work of kidneys by filtering out toxic substances (i.e., waste products and uremic toxins) and extra fluids from the blood to prevent harmful consequences that may occur from the accumulation of these substances in the body. It forms side by side with kidney transplantation the major types of kidney replacement therapy (KRT) that is used as a treatment for patients with inadequately working kidneys. Hemodialysis (extracorporeal method) and peritoneal dialysis (Paracorporeal method) are the two main modalities of dialysis.[1] Among the three types of KRT (hemodialysis, peritoneal dialysis, and kidney transplantation), hemodialysis is the most commonly used globally. It is received by 89% of dialysis patients and 69% of all KRT population.[2]

Drugs' dialyzability is the extent to which a drug is washed out of the blood via dialysis procedure. Simple diffusion is the main mechanism through which a drug is migrated from the blood to dialysis fluid (the dialysate). Physicochemical properties of the drug (its molecular weight, hydrophilicity, binding to plasma protein, and

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distribution volume), as well as the properties of dialysis procedure (membrane characteristics, flow rates of the blood and dialysate across the membrane, and dialysis duration) are the main controllers for the dialyzability of a given drug.[3] Accordingly, drugs are fallen into one of two categories, dialyzable drugs, that are affected and removed to a given extent through dialysis. And nondialyzable drugs, that remain in the blood and are not affected by dialysis.[4,5]

In general, to avoid the consequences of drug dialyzability and to ensure effective drug level until the next dosing, dialyzable drugs should be given after finishing dialysis session. Otherwise, in addition to the dose adjusted according to patient's GFR, a suppurative dose of the parent drug should be given after completing the session to replace what was removed during dialysis.[4-7] Another study revealed that under dose due to dialysis clearance can be overcome through increasing the administered dose of the dialyzable drug to ensure adequate therapeutic efficacy after dialysis.[8] These methods are only applicable to patients undergoing intermittent hemodialysis (IHD), but it is not needed with continuous peritoneal dialysis. Indeed, during hemodialysis, sharp decrease in drug concentration occurs; however, the removal is gradual and persistent.[6,9]

Clinical pharmacist is one of the healthcare providers, who is responsible for providing the pharmaceutical care, which is defined as a practice through which a pharmacist shows his role and offers expertise in a professional capacity to ensure patient safety.[10-13]

At dialysis wards, clinical pharmacists have a dual responsibility. They undertake the responsibility of counseling medications with key information (i.e., dose, timing, side effects, and contraindications) to reach the maximum benefit with the least harmfulness. On the other hand, in a communal capacity, they play a key role in raising the awareness of dialysis patients by encouraging them to adhere to their medications—including dialysis session itself—and to ask about the right manner and time to take these medications.[14,15]

This study aimed to evaluate and improve the knowledge of the pharmacists, who were working at dialysis wards regarding drugs' dialyzability.

Materials and Methods

An observational pre–post interventional study was conducted from November 2022 to February 2023. The study was oriented to the pharmacists, who were working in dialysis wards of one of four health institutions, namely Al-Hakeem General Hospital, Al-Sader Medical City, Al-Najaf Educational Hospital, and Dialysis and Blood Diseases Center, in Al-Najaf city, Iraq. The study aimed to evaluate pharmacists' knowledge regarding drugs' dialyzability. The selection of the four mentioned institutions is due to containing the main dialysis wards in the city.

The study was based on a questionnaire, that had been written by the authors, and tested for validity with four academically experienced specialists, including a clinical pharmacy specialist, two pharmacology specialists, and a biostatistics specialist. According to their comments and considered modifications the revised questionnaire was sent to 10 pharmacists to perform a pilot study and the Cronbach alpha value was 0.84.

The questionnaire consisted of three sections. the first one contained five questions asking about pharmacists' demographic data (age, gender, degree, institution, and years of experience at hospitals pharmacy). The second section contained one open-ended question asking about the meaning of the term "drug dialyzability," and 11 multiple choice questions asking general information about dialysis and drugs' dialyzability. While the last section asked about the dialyzability of 13 of the most commonly used drugs at dialysis wards. Each correct answer gave one point, while, incorrect or "not sure" answers gave 0 point. the full score for the whole questionnaire was 25 points. The resulting total scores ranged from 0 to 25, where a result of greater than 18 indicated good knowledge, 13–18 indicated fair knowledge, whereas, result of lesser than 13 indicated inadequate knowledge.

The questionnaire was delivered by hand to the 36 pharmacists who were working in the dialysis wards of the four institutions. They were told that the questionnaire was for scientific research, need 10 min maximum to be filled and confidentiality surely will be kept. The participation was voluntary and the pharmacists waited to fill the questionnaire and returned the papers.

After completing the survey, the interventional phase was started. An hour of scientific lecture regarding the subject was given twice in each institution, to ensure that all the participant pharmacists attend it. The lecture contained three main axes. A theoretical axis explaining the subject. A practical axis to explain dialyzer types, and how changing the type can affect the dialyzability, as well as a third axis showed the most important references that can be referred to know the dialyzability of a particular drug. At the end of the lecture, a session of questions and answers was opened. Then, the questionnaire was redistributed.

As a second educational tool, a poster was hanged on dialysis wards of the four institutions. The poster contained 300 of the most commonly used drugs and their dialyzability state with three different membranes (high-flux and low-flux membranes used in hemodialysis, as well as the peritoneal membrane). Additionally, the poster contained a conversation (as a short story) between

a pharmacist and a nurse to clarify the objective of the poster to anyone read it.

To evaluate the retained knowledge, the same questionnaire was redistributed after 2 months from the lecture.

Statistical analysis

The data were analyzed using version 24 of SPSS program. Frequencies and percentages were used to express categorical data. While mean and median were used to express continuous variables. The normality of the data was tested using Shapiro–Wilk test. Because the data were not normally distributed, then, nonparametric Friedman test was used to compare the difference in knowledge between the three responses (before, immediately after, and after 8 weeks from the educational intervention). The *P* value was significant when the result was <0.05, while *P* value of greater than 0.05 means no significant difference in knowledge between the three responses.

Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with pharmacists' verbal approval after outlining the purpose of the study. The study was approved by the Ethical and Scientific Committee of Researches of Al-Najaf Health Directorate according to the document number 43428 on October 27, 2022.

Results

From the 36 pharmacists received the questionnaire, 32 (88.8%) accepted to enroll in the study. Four pharmacists who refused to fill the questionnaire were all from Al-Sader Medical City. All of the participants hold a bachelor's degree in pharmaceutical science. The majority were females (84%), and with the age group of lesser than or equal to 30 years old (87.5%). Moreover, about the half were with <1-year experience in hospital pharmacy. Other characteristics are shown in Table 1.

Table 1: Demographic data of the participant pharmacists

Variables	No.	%
Age		
≤30 years	28	87.5
31–40 years	4	12.5
>40 years	0	0
Gender		
Male	5	15.63
Female	27	84.37
Highest educational level attained		
Bachelors	32	100
Higher diploma	0	0
Masters	0	0
Working place		
Al-Hakeem General Hospital	7	21.875
Al-Najaf Educational Hospital	11	34.375
Al-Sader Medical City	4	12.5
Dialysis and Blood Diseases Center	10	31.25
Years of work experience (in hospital pharmacy)		
<1 year	15	46.875
1–3 years	7	21.875
4–7 years	6	18.75
8–10 years	2	6.25
>10 years	2	6.25

Pre-intervention phase

The analysis of the data revealed that the mean percentage of knowledge of the 32 participants was 43.5%. Three pharmacists only (9.38%) were able to write the right meaning of the term drug dialyzability in the open-ended question. Approximately, 45% answered correctly that some drug properties like molecular weight, volume of distribution, and protein binding can affect its dialyzability. Whereas, only 18.75% knew that some technical aspects of dialysis procedure like membrane properties, duration of dialysis, and the flow rates of blood and dialysate also can affect drug dialyzability. Half of the participants (50%) recognized the right way to avoid this problem. The percentages of right answers for the third part of the questionnaire were ranged from 22% for eprex to 56% for carvidilol and folic acid. More details are shown in Table 2.

Post-intervention phase

After establishing the educational program, the mean percentage of knowledge increased to 78.875%. At this phase, all of the participants (100%) knew the exact meaning of drug dialyzability. The majority knew that drug properties can affect drug dialyzability. Whereas, 66% (n = 21) knew about the effects of technical aspects on it. Almost all of the participants, 94% (n = 30), at this phase recognized the right way to avoid this problem. The percentages of right answers for the third part of the questionnaire were ranged from 53% for amlodipin to 93% for gentamicin.

The retained knowledge after 8 weeks was so good, where the mean percentage of knowledge was only slightly decreased to 74.25%. Most of the participants (71.8%) defined drugs' dialyzability correctly. The majority knew about the factors that can affect and the way to avoid it. The percentages of right answers for the dialyzability of the 13 drugs was ranged from 56.25% for aspirin to 87% for heparin [Table 2].

Levels of knowledge

Before intervention, only three of the participant pharmacists achieved a knowledge score of greater than 17 points and considered with good knowledge, Whereas, about two-thirds of the participants, 65.6% (n = 21),

Table 2: Difference in mean knowledge of the participant pharmacists between the three phases of the study

Item	Before intervention		After intervention		Retained (after 8 weeks)		*P* value
	Correct response		Correct response		Correct response		
	No.	(%)	No.	(%)	No.	(%)	
Drug dialyzability is the extent to which a drug is removed from the blood through dialysis procedure	3	9.38	32	100.00	23	71.88	0.000
End stage renal disease (ESRD) is a condition where GFR is less than 15 mL/min/1.73 m^2	18	56.25	24	75.00	28	87.50	0.006
Before dispensing medications for chronic dialysis-dependent patients, the pharmacist should check the level of creatinine clearance	28	87.50	32	100.00	24	75.00	0.008
Any type of KRT (hemodialysis, peritoneal dialysis or kidney transplantation) can be used to treat patient with ESRD	11	34.38	23	71.88	25	78.13	0.001
Dialyzable drug is the drug that can be removed through dialysis	24	75.00	32	100.00	32	100.00	0.000
Drug is more able to be dialyzed if it has low molecular weight	17	53.13	26	81.25	25	78.13	0.042
A drug with high volume of distribution (V_d) needs long time to be dialyzed	15	46.88	23	71.88	25	78.13	0.007
A drug with low protein binding is the more dialyzable drug	13	40.63	27	84.38	29	90.63	0.000
Dialysis properties like membrane material, blood and dialysate flow rates and duration of dialysis can affect drug dialyzability	6	18.75	21	65.63	19	59.38	0.001
If a patient is on dialysis, it's important to check drug dose, timing and drug–drug interaction	11	34.38	20	62.50	21	65.63	0.008
To avoid drug's dialyzability, the pharmacist should administer the drug after dialysis session or before dialysis with a suppurative dose after dialysis session	16	50.00	30	93.75	24	75.00	0.001
In addition to standard use, dialysis can also be used for acute poisoning	23	71.88	29	90.63	29	90.63	0.050
Carvidilol is a nondialyzable drug	18	56.25	19	59.38	19	59.38	0.957
Heparin is a nondialyzable drug	11	34.38	28	87.50	28	87.50	0.000
Insulin is a nondialyzable drug	15	46.88	25	78.13	24	75.00	0.011
Gentamicin is a dialyzable drug	15	46.88	30	93.75	25	78.13	0.000
Metformin is a dialyzable drug	14	43.75	18	56.25	21	65.63	0.200
Lisinopril is a dialyzable drug	12	37.50	24	75.00	19	59.38	0.009
Digoxin is a nondialyzable drug	14	43.75	24	75.00	20	62.50	0.018
Methotrexate is a dialyzable drug	8	25.00	23	71.88	23	71.88	0.000
Amlodipine is a nondialyzable drug	11	34.38	17	53.13	24	75.00	0.008
Aspirin is a dialyzable drug	14	43.75	21	65.63	18	56.25	0.128
Meropenem is a dialyzable drug	13	40.63	30	93.75	23	71.88	0.000
Eprex is a nondialyzable drug	18	56.25	29	90.63	19	59.38	0.000
Folic acid is a dialyzable drug	7	21.88	24	75.00	27	84.38	0.005
Sum	355	44.38	631	78.88	594	74.25	0.000

were with inadequate knowledge level. This ratio was completely inverted after intervention. No one of the participants (0%) remained with inadequate knowledge level. Moreover, after 8 weeks from the established educational intervention, almost all of the participants at this phase (97%, $n = 31$) were with good to fair knowledge level [Figure 1].

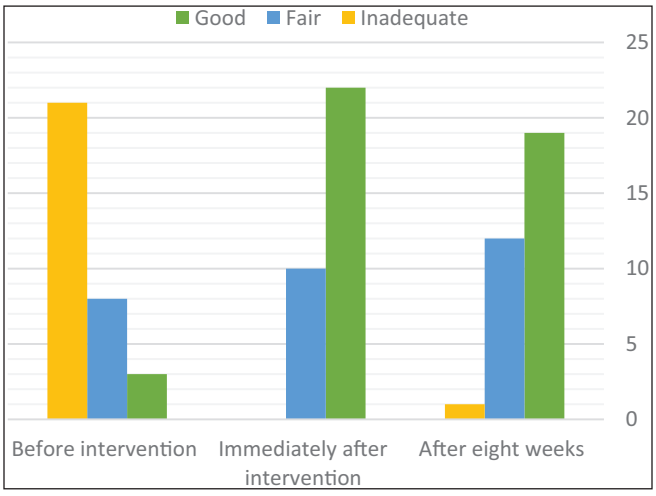

Figure 1: Levels of knowledge before and after intervention

Discussion

The risk of medication-related problems in hemodialysis patient's was mentioned in several studies.[12,16-18] One of these problems is sub therapeutic dosage, which is defined as treating a medical problem with a dose less than the needed dose. This problem may occur secondary to drug dialyzability for dialyzable drugs whenever given before dialysis session.[19]

The need for dose adjustment and the dialyzability state are of the most important things to be checked before dispensing a drug for dialysis patients.[20] Antibiotics resistance,[21] loss of chemotherapies efficiency,[22] and inability to control blood pressure[23,24] are the results of administering dialyzable antibiotics, chemotherapies, and anti-hypertensives at the wrong time.

To the best of our knowledge, this study was the first to examine pharmacists' knowledge regarding this important concept. And when it was the first, there was no previous tool (questionnaire) to be used. Hence, a new tool was made and validated before utilization.

Pharmacists who were working at dialysis wards were requested to join the study. The majority of them showed great interest, which was led to a good response rate accounted for approximately (89%). The observation phase revealed inadequate knowledge of the participants regarding the subject, where the mean percentage of knowledge was 44%. There are no previous literatures to compare our results with them. However, in Pakistan, a study was conducted to evaluate pharmacists' knowledge regarding chronic kidney disease using a questionnaire. The percentage of right answers for the only one question asked about the dialyzability was 24.6%.[25] This finding indicated a real need for educational intervention to improve pharmacists' knowledge regarding drugs' dialyzability, which was done using a scientific lecture as well as a poster.

The educational program showed a significant improvement in pharmacists' knowledge where the mean percentage of knowledge was doubled immediately after intervention ($P < 0.001$), demonstrating the program's applicability. that is, comparable to the results of many educational intervention, where the knowledge score increases after intervention.[26-28] Interestingly, even after a period of 8 weeks, the mean percentage of knowledge was only slightly decreased, with no significant difference ($P = 0.782$) from the mean percentage of knowledge conducted immediately after intervention. Indeed, after 8 weeks, pharmacists' knowledge still significantly differs from the base line knowledge ($P < 0.001$). This can be related to the high interest of the participants regarding the subject, where for many of them it was the first time to hear about it. Additionally, this may be because the researchers provided improved health education and information.[29]

Knowledge scoring system is one of numerous scoring systems adopted in many published literatures. Three classes: good, fair, and inadequate were conducted. Answering >70% of the questionnaire indicated good knowledge level. Whereas, fair and inadequate levels of knowledge were considered when the participants answered 51%–70% and <50% of the questionnaire, respectively.[30-33]

The previous results denote the need for implementing continuous educational programs and workshops for pharmacists to maintain updated knowledge after graduation.

Conclusion

The impact of the educational intervention is obviously touchable, where the knowledge score of the participants was doubled after establishing it. Farther more, this increment in the knowledge remained approximately at the same level even after 2 months of the intervention. Indeed, continuous educational programs are useful for maintaining the knowledge in progress.

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Conflicts of interest

There are no conflicts of interest.

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