Prevalence and Causes of Early Termination of Hemodialysis Sessions

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Abstract

Background: Hemodialysis patients often do not complete their full length of time on dialysis. However, neither the magnitude nor the potential reasons for this problem are known.

Objective: The prevalence and causes of early termination of hemodialysis sessions were prospectively studied at Al-Kadhimya Teaching Hospital Hemodialysis Unit.

Methods: This unit provided a total of 272 hemodialysis sessions in a three months period to an average of 39 patients.

Results: There were a total of 42 early terminations (15.44%) during this three months period. The most common causes of early termination were chest pain (23.8%), followed by hypotension (16.66%), extracorporeal clotting (11.9%) and a late-start treatment (9.52%).

Conclusion: In sum, approximately 83% of early termination due to medical and hemodialysis related problems, whereas most of the remainder occurred because of either started treatment late or noncompliance with the dialysis prescription.

This information should be of value when designing programs intended to reduce the number of early terminations in hemodialysis patients.

Keywordes: chronic renal failure, Haemodialysis, Hepatitis B&C, Blood pump speed, transmembrane pressure

Introduction

Unlike other form of end stage organ failure, renal failure is unique in having three modalities of therapy: Hemodialysis, peritoneal dialysis and renal transplantation. In hemodialysis, solute removal occurs predominantly by diffusion,fluid removal(in hemodialysis) occurs by the process of ultrafiltration

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The ultrafiltration rate is determined by the hydrostatic pressure gradient across the dialysis membrane-called trans-membrane pressure.

During dialysis the ultrafiltration rate is adjusted to obtain the desired fluid lose. Each form of renal replacement therapy has its unique benefits and risk [1]. Because of general availability of all treatment modalities, medical suitability and patient preference are typically the sole determinant of renal replacement therapy [2].

Lazarus and his colleagues noticed that several factors influence the

likelihood of complications during fluid removal by dialysis. These include volume of the dialyzer and blood line, compliance of the dialyzer (that is the degree of expansion of the blood compartment with increasing pressure), and the magnitudes of ultrafiltration [3].

Other factors such as uremic autonomic neuropathy, hormonal changes and myocardial diseases may complicate the effect of reducing the vascular volume [4, 5].

Hypotension during dialysis, which occurs in 10% to 50% of the treatment, is the most frequent complication of dialysis [6]. Although other factors may contribute, ultrafiltration induced volume depletion is the most important cause. It is particularly important to recognize that hypotensive episodes can result also from coronary ischemia, arrhythmia, or pericardial effusion with tamponade [7]. The control of blood pressure during dialysis is a complex process resulting from the interaction of several mechanism controlled, at least partly, by autonomic nervous system. Therefore, it is suggested that hemodialysis induced hypotension may be due to an impairment autonomic control [8].

Muscle cramps are a non-life-threatening morbid occurrence in chronic renal failure [9]. Their precise incidence is uncertain, but at least 20% of patients report their occurrence during dialysis [10].

Atrial and ventricular tachyarrhythmias and varying degrees of heart block are not unusual occurrences during hemodialysis [11]. These rhythm disturbances typically occur in the setting of underlying cardiovascular diseases, such as coronary artery disease, hypertensive cardiomyopathy, ischemic cardiomyopathy, hypertrophic cardiomyopathy, conduction system diseases, and pericardial disease [12]. Further, many of the intended and undesired intradialytic alteration in the serum electrolytes, bases, and arterial oxygen saturation are themselves arrhythmogenic [13].

Dialysis disequilibrium syndrome is an admixture of symptoms that include headache, nausea, vomiting, and hypertension which can progress to arrhythmias, confusion, tremor, seizures, coma, and death.

Pyrogen reaction is the term used for the intradialytic or postdialytic febrile event that arise as an immediate consequence of an intradialytic exposure to bacteria (with out bacteremia) or to a bacterial products in the absence of a clinical infection. These reactions which are characterized by fevers, chills, rigors, myalgias, and hemodynamic instability, typically occur during the second half of the dialysis session [2].

Air embolism remains an ever-present risk because of the use of blood pumps in combination with an extracorporeal circuit, and the frequent insertion and use of central venous catheter [14].

Although the incidence of insertion complications varies with the approach used, the principal risk factor is physician inexperience [15]. Signs and symptoms may result from the introducer needle, guide wire, or catheter, as well as the local effect of expanding hematomas [16].

Inadequate dialysis dose is independently associated with increased hospitalization, hospital days, and medicare inpatient expenditures improving dialysis adequacy may both improve patient morbidity and lessen health care cost [17].

Patients can improve dialysis adequacy by complying with their prescribed treatment time [9].

Aim of the study

The aims of this study are to asses:

(1) The prevalence and causes of early termination of hemodialysis sessions.

(2) The relationship of medically related causes of early termination with the transmembrane pressure and blood pump speed.

Patients and method

The study was conducted at Al-Kadhymia Teaching Hospital Dialysis Unit .Two hundreds and seventy two dialysis sessions were studied in three months period between May and July 2005 .The number of patients who underwent these sessions was 39(27 male and 12 female), thirty of these patients were hepatitis virus negative, eight HCV positive and only one patient was HBV positive. Their age range was from (14 to 75 years) with a mean of (44.15 ±2.48 years).

Heart rate blood pressure and temperature were measured every thirty minutes. A special form was filled for each dialysis session which included the necessary information about the patient and dialysis and the cause of early termination of hemodialysis session.

All dialysis sessions were on Fresinius Medical Care 4008B and Gambro equipments (AK-10 pumps and UDM 10-1 fluid monitor). Fresenius Polysulfone Capillary Dialysers (6) and (7) having surface area (1.2 m2) and (1.4 m2) respectively were used. Hemodialysis schedule was 3-4 hours once to twice a week. Hemodialysis

sessions that stopped before three hours considered as early termination. The composition of the dialysate was as follows:

Sodium	133mmol\L
Chloride	97mmol\L
Calcium	1.5mmol\L
Potassium	1.5mmol\L
Magnesium	0.8mmol\L
Acetate	40mmol\L
Glucose	2.1g\L

Hypotension was diagnosed when systolic blood pressure dropped to less than 90 mmHg [18], patients who experienced hypotensive episode when on dialysis were treated by reducing the rate of ultrafiltration, administering of intravenous saline or both.

The need for ultrafiltration was estimated by the attending physician before each dialysis session based on clinical ground .The system was primed with saline. Heparin was given at the beginning of the hemodialysis sessions in a dose of 5000 I.U.

Data for the causes of early termination were grouped into five arbitrary categories, including medically related, hemodialysis related, a late-start treatment, noncompliance, and personal causes. Statistical analyses were made using chi squire X^2 test. P value less than 0.05 was considered significant.

Results

A total of 272 hemodialysis sessions were performed in three months period from May to July 2005.

Prevalence of Early Termination

There were a total of 42 early terminations during this same period. Therefore, early termination occurred in (15.44%) of dialysis treatment provided. Dialysis treatments were shortened by a total of (2889 minutes), with an average of (68.9 ± 8.4 minutes) per early termination.

Causes of Early Termination

The causes of early termination were arbitrary categorized into five categories and are enumerated in (Table 1). Medical related causes, accounted for approximately (35.71%) of all early termination. Dialysis related causes accounted for (47.61%) of all early termination. Patient who started treatment late accounted for (9.52 %) of all early termination, whereas noncompliance with the dialysis prescription and personal causes contribute to an additional (7.14%) of all early termination.

The most common medical cause of early termination was chest pain and it accounted for almost two third of early termination in this group. It was also the most common single over all cause of early termination (Table 2). Patients who were placed in this category did not have low blood pressure or cramping as a cause of their early termination. Other causes of early termination in this category included arrhythmias, vomiting, confusion and feeling bad or sick.

Low blood pressure was the most common cause for an early termination due to dialysis-related problems and both are regard the most common single overall cause for early termination. The second cause in this category was extracorporeal clotting followed by equipment malfunction, cramping, shortage of dialysate and access problems. A staff member would initiate an early termination of hemodialysis sessions when the patient arrived late to the dialysis unit and this accounted for (9.52%) of overall causes of early termination.

Early termination that was at least partially controlled by the dialysis patient is enumerated in the categories "Noncompliance" and "personal causes". In Noncompliance category including patients who were refuse to complete their dialysis session prescribed with no reason just want to end session. Finally, there was only one early termination due to personal business.

Number of early termination per patient

A small proportion of patients accounted for a large majority of early terminations. There were four patients accounted for (40.5%) of all early termination and dialysis treatments were shortened by a total of (885minutes). The causes of early termination were the same overtime in two patients and were not the same in the others. Eighteen patients accounted for (59.5%) of all early termination during the study period and the dialysis treatments were shortened by a total of (2004 minutes).

The prevalence of most of the early termination due to medical signs and symptoms was highest when the transmembrane pressure was (0-100 mmHg) (Table 3) and blood pump speed of (101-200ml/minute) (Table 4).Most of the early termination of hemodialysis sessions occurred after two hours from the start of treatment (Table 5).

Table 1: causes of early termination of hemodialysis sessions

Category	No. (% of total)	No.(% in each category)
Medical causes	15 (35.71)	
✳ Chest pain		10 (66.66)
✳ Arrhythmias		2 (13.33)
✳ Vomiting		1 (6.66)
✳ Confusion		1 (6.66)
✳ Feels "bad/sick"		1 (6.66)
Dialysis related causes	20 (47.61)	
✳ Low blood pressure		7 (35)
✳ Extracorporeal clotting		5 (25)
✳ Machine malfunction		
✳ Cramping		3 (15)
✳ Shortage of dialysate		2 (10)
✳ Access problems		2 (10)
		1 (5)
Started treatment late	4 (9.52)	4 (100)
Non compliance (No cause, just went to end session)	2 (4.76)	2 (100)
Personal causes	1 (2.38)	1 (100)
✳ Personal business		
Total	42	

No. = number

(%) = percentage

Table 2: most common causes of early termination

Cause	No. (%)
Chest pain	10 (23.8)
Hypotension	7 (16.66)
Extracorporeal clotting	5 (11.9)
Late start treatment	4 (9.52)
Machine malfunction	3 (7.14)
Total	29 (69.02)

No. = number

(%) = percentage

Table 3: Relationship between causes of early termination of hemodialysis sessions due to medical signs & symptoms and transmembrane pressure:

Causes of early termination	TMP (mmHg) No. (%)			X^2 value P value
	1 (0-100)	2 (101-200)	3 (201-300)	
Chest pain	7 (24.1)	3 (10.3)		1.15 NS 0.28
Hypotension	4 (13.8)	1 (3.4)	2 (6.9)	3.27 NS 0.25
Extracorporeal clotting	4 (13.8)	1 (3.4)		0.57 NS 0.32
Arrhythmias	2 (6.9)			
Cramping	2 (6.9)			
Vomiting		1 (3.4)		
Feels bad /sick		1 (3.4)		
Confusion	1 (3.4)			
total	20 (69)	7 (24.1)	2 (6.9)	

TMP =Trans-Membrane Pressure
No. =number.
(%) =percentage.
NS =not significant.
Difference between 1 and 2 not significant
Difference between 1 and 3 not significant
Difference between 2 and 3 not significant

Table 4: Relationship between causes of early termination of hemodialysis sessions due to medical signs & symptoms and B.P.S. (ml/min).

Causes of early termination	B.P.S (ml/minute) No. (%)			X^2 value P value
	1 (50-100)	2 (101-200)	3 (201-300)	
Chest pain	1 (3.4)	9 (31)		0.63 NS 0.78
Hypotension	1 (3.4)	6 (20.7)		0.33 NS 0.36
Extracorporeal clotting	1 (3.4)	3 (10.3)	1 (3.4)	3.07 NS 0.43
Arrhythmias		1 (3.4)	1 (3.4)	
Cramping		2 (6.9)		
Vomiting		1 (3.4)		
Feels bad /sick		1 (3.4)		
Confusion		1 (3.4)		
total	3 (10.3)	24 (82.8)	2 (6.9)	

B.P.S. = Blood Pump Speed

No. = number.
(%) = percentage.
NS = not significant.
Difference between 1 and 2 not significant
Difference between 1 and 3 not significant
Difference between 2 and 3 not significant

Table 5: Relationship between causes of early termination of hemodialysis sessions and time of disconnection after starting

CAUSES OF EARLY TERMINATION	TIME OF DISCONECCTION FROM START NO. (%)			P VALUE
	1 (0-59)minutes	2 (60-119)minutes	3 (120-179)minutes	
Chest pain	1(2.38)	1(2.38)	8 (19.04)	0.64 NS
Hypotension	0	2(4.76)	5 (11.9)	0.64 NS
Extracorporeal clotting	2(4.76)	2(4.76)	1(2.38)	0.12 NS
Started treatment late	0	0	4 (9.52)	
Machine malfunction	0	0	3 (7.14)	
Cramping	0	1(2.38)	1(2.38)	
Shortage of dialysate	0	1(2.38)	1(2.38)	
Arrhythmias	1(2.38)	0	1(2.38)	
Noncompliance	0	0	2(4.76)	
Personal business	0	0	1(2.38)	
Vomiting	0	0	1(2.38)	
Confusion	0	0	1(2.38)	
Feels bad / sick	0	0	1(2.38)	
Access problem (expanding hematoma	0	1(2.38)	0	
Total	4 (9.5)	8 (19.1)	30 (71.4)	

Discussion

Early termination of hemodialysis sessions is a significant problem that occurs in 42 out of 272 of hemodialysis sessions.

The medical literature has little information on magnitude and causes of early termination. In comparison with a previous study was done at a large hemodialysis unit in south eastern United States [9], there was (6.8%) of early termination. The most common causes of early termination were cramping (17.9%), followed by "feels bad or sick" (14.2%), personal business (12.1%), lack of transportation later in the day (7.7%), and refusal to comply with the prescribed treatment time (6.4%). While in our study the prevalence of early termination was (15.44%), and the most common causes of early termination were chest pain (23.8%), hypotension (16.66%), and extracorporeal clotting (11.9%). In other study [19] some of the most common causes why the duration of dialysis delivered were less than the duration of dialysis prescribed included patient refusal to complete the full treatment time in (25%), medical complication (14.3%), and patients arriving late for their treatment in (10.7%).

Differences in the incidence of early termination between different countries also exist when identical dialyzers and blood lines are used. This is most probably related to differences in experience, education and attitude of medical staff and patients. The numerous other co-morbid conditions those are often present in dialysis patients such as congestive heart failure or ischemic heart disease, may also contribute to early termination due to medical reasons [20]

Approximately, 47.61% of causes of early termination were due to the result of problems that could be related to dialysis process, such as low blood pressure, extracorporeal clotting, machine malfunction, and cramping. In some hemodialysis patients the prevention of hypotension and its associated signs and symptoms may be more difficult. In those patients, there may be autonomic nervous system dysfunction that may result in the absence of either a reflex tachycardia or reflex vasoconstriction when volume depletion is present [21, 22, 23].

Other dialysis related problems such as, extracorporeal clotting may be due to method of heparinization used which was 5000I.U at the beginning of sessions rather than fractionated heparin doses. Machine malfunction was another dialysis related problem for early termination and could be attributed to the duration of the use of the equipments in the unit.

Unfortunately, the shortage of the dialysate was another dialysis related problem that causing early termination. Vascular access complications were recorded as a cause of early termination in only one case because of development of a swelling in the neck and the opinion of a cardiothoracic surgeon was an expanding hematoma as a complication of insertion of double lumen internal jugular catheter.

It is important to know that about 16.66% of early termination was related to patients' desire either to disagree with the attending physician's recommendations or due to personal obligations. This observation suggests that patients may not be aware of the importance of the relationship between the time on dialysis and mortality and

morbidity. Parts of this difficulty may lie in the misperception that the time prescribed for dialysis is based on the weight gain between dialysis sessions and not other laboratory parameters. In support of this hypothesis is: the observation that some aspect of compliance may be related to the patient's knowledge regarding the treatment regimen [24, 25, 26, 27].

The incidence of most complications of hemodialysis was higher when a significant trans-membrane pressure gradient was used which is not surprising as more fluid is lost from the intravascular compartment, plus perhaps removal of some vaso-active peptides [28, 29]. However, finding more early termination of hemodialysis sessions due to medical reasons with a trans-membrane pressure range (0 - 100mmHg) than a range of (101-200mmHg) was unexpected. This may be artificial being caused by policy of the staff of the unit of increasing the trans-membrane pressure gradually and slowly , in support of this opinion is that the sessions that were complete there full duration of time prescribed and not early terminated which were 230 sessions 42.7%of them (98sessions)were advanced to a range of (0-100mmHg)and 29.5%of them (68sessions) were advanced to a range of (101-200mmHg) while only 27.8%(64 sessions)were advanced to a range of(201-300mmHg) .

So patients who were liable to complications developed it in a low and intermediate range and consequently were not advanced to higher range, which therefore included patients who are less liable for complications. A similar explanation may apply to the finding that more early termination occurred with blood pump speed of 101-

200ml\min.than a blood pump speed of 201-300ml\min. which was also unexpected.

Some causes of early termination due to personal reasons such as patients came to treatments late and personal business, because of inflexible dialysis schedules makes such choices unavoidable.

Conclusions

Large number of hemodialysis patients does not remain for the full length of time prescribed for their dialysis treatment and these behaviors have an effect on the morbidity and mortality of these patients.

The most common cause of early termination was chest pain and there is no significant relationship of medically related causes of early termination with the trans-membrane pressure and the blood pump speed.

Recommendations

This information should be of value when designing programs intended to reduce the number of early termination in hemodialysis patients.

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