Headache Associated with Hemodialysis in Patients with End-Stage Renal Disease in India: A Common Yet Overlooked Comorbidty

Kishl T. Chhaya, Saptak Mankad, Maulin K. Shah, Mamta Patel, Devangi Desai, Soaham D. Desai
Departments of Medicine, *Department of Biostatistics, Central Research Services, Shree Krishna Hospital and Pramukhswami Medical College, Bhakaka University, Karamsad, Anand, Gujarat, *Departments of Neurology, Shree Krishna Hospital and Pramukhswami Medical College, Bhakaka University, Karamsad, Anand, Gujarat, India

Abstract

Background: Headache is a frequently encountered symptom among patients undergoing hemodialysis. Aim: The aim of this study was to elucidate the prevalence of hemodialysis associated headache (HDH), its possible etiology, its effect on the patients and steps taken in the management of the condition in Indian patients with end-stage renal disease (ESRD). Methods and Materials: A cross-sectional study was carried out amongst 128 consenting patients with ESRD on regular hemodialysis at a tertiary care medical teaching hospital over a period of 3 months to assess for prevalence of HDH and factors related to it. The pre hemodialysis serum electrolytes level, pre and post hemodialysis systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded. Visual analogue scale (VAS) and patient health questionnaire-9 (PHQ9) was administered to the patients. r Test and Chi-square test were applied to find the association between HDH and various postulated factors and a regression analysis was performed. Results: Among 128 patients, 48 (37.5%) (men 18 [37.5%], women 30 [62.5%]) were found to have HDH. The mean headache severity scores on (VAS) was 4.5 ± 1.74. Patients having HDH had their mean PHQ9 scores 7.56 ± 4.51. Most patients had headaches in the first hour of dialysis and were located in the frontal and temporal part of the head. No statistically significant difference was found in the electrolyte levels between patients having HDH and without HDH. The headache was moderate in most but needed a paracetamol tablet to relieve the headache. Conclusion: Nearly one-third of patients undergoing dialysis have HDH, and it is associated with mild to moderate depression. The factors leading to HDH and its management need to be evaluated further to improve the quality of life of patients with ESRD on dialysis.

Keywords: Chronic kidney disease, depression, hemodialysis, hemodialysis headache

INTRODUCTION

Patients with end-stage renal disease (ESRD) on maintenance hemodialysis (MHD) are often found to suffer from headaches during and following the dialysis sessions. Hemodialysis headache (HDH) was first described by Bana et al. in 1972 and in 1988 International Headache Society (IHS) gave a detailed description of the same. HDH generally starts during the sessions and resolves after the session within 72 h. It was suggested that changes in the electrolytes during the hemodialysis session could be a reason for headache to develop which may be attributed to dialysis disequilibrium syndrome. In the International Classification of Headache Disorders-3 (ICHD3), it is classified under the subheading of headache disorders attributed to disorders of homeostasis. Different etiology were proposed in further studies that included changes in electrolytes during dialysis, hypertension, bone mineral disorder, mental health of the patient among many others. ICHD3 beta classification has well defined criteria for HDH. There is a lack of data with regards to prevalence of HDH amongst Indian patients with ESRD undergoing MHD. However, headache is found to be a common symptom amongst these patients in clinical practice. It is necessary to identify the high-risk individuals, accurately diagnose it, take steps for its prevention and management, and improve the wellbeing of the patients. We initiated this study to elucidate the prevalence of HDH amongst patients with ESRD undergoing MHD at our hospital, assess its clinical characteristics, its impact on the patients’ mood, associated factors and the measures used by patients for its management.

MATERIALS AND METHOD

We conducted a questionnaire-based cross-sectional study amongst patients with ESRD undergoing MHD at a tertiary...
care medical hospital and teaching facility in western part of India after getting prior approval from the Institutional Research Ethics Committee. All patients who consented and were undergoing MHD regularly for more than 6 months were included in the study. ICHD 3 beta classification for HDH was used to diagnose HDH in these patients [Table 1]. Patients with baseline intracranial pathology which could lead to headache like recent head trauma, stroke, infection, tumor, and those with comorbid delirium/dementia were excluded. Visual analogue scale (VAS), a validated scale to assess pain severity was administered to estimate the subjective intensity of headache and patient health questionnaire-9 (PHQ-9) was administered for screening, diagnosing and measuring severity of depression in the patients undergoing maintenance HD. Pre-dialysis and post-dialysis blood pressure were recorded using a manual sphygmomanometer. Biochemical parameters consisting of serum sodium, potassium, creatinine, urea, magnesium were recorded along with the etiology of chronic renal failure. Patients were inquired about the measures taken to control the headache including the consumption of tea or coffee during hemodialysis sessions. The data was compiled and analyzed using independent t test and chi square test.

**RESULTS**

A total of 131 patients fulfilling inclusion and exclusion criteria were approached, out of which 3 refused consent for participating in the study. Amongst 128 patients studied, 82 (64%) were men and 46 (36%) were women. Majority of the patients developed ESRD secondary to hypertension (28, 58%) followed by diabetes mellitus with hypertension (9, 19%) followed by mineral bone disorder (6, 13%). The mean age of the patients was 47.2 ± 17.3. 48 (37.5%) patients were diagnosed to have HDH. Amongst those having HDH, 18 (37.5%) were men and 30 (62.5%) of them were women. The site of headache was frontotemporal (22, 46%), frontal (18, 38%), temporal (3, 6%), parietal (3,6%), and occipital (2, 4%). The time of onset of HDH in 25 (52.08%) patients was between the first and second hours of HD session and the duration for which headache persisted after the hemodialysis session ended, in 34 (70.83%) participants, was within 1 h of completion of hemodialysis. Amongst the patients with HDH, 17 (13.28%) patients had begun experiencing HDH at the first dialysis itself. Amongst the patients with HDH, 20 (41.67%) (P = 0.003) had a baseline headache disorder before initiating dialysis, but 28 (58.33%) developed HDH de-novo. The mean (standard deviation [SD]) VAS scores for severity of pain were 4.5 ± 1.74 and median (IQR) was 4.5 (3–7). Patients having HD headache showed a mean score of 7.56 ± 4.51 on PHQ9, whereas patients not experiencing HD headache showed a mean score of 2.58 ± 1.63 [Table 2].

The difference in mean pre-dialysis diastolic blood pressure (DBP) values of patients with and without HDH was significant (P = 0.02). No significant difference was found in the electrolyte levels between patients having HDH and without HDH. Patients who were having thrice a week hemodialysis session had increased frequency of headache (27, 56.26%) (P = 0.01) as compared to patients on twice a week hemodialysis session (21, 44.75%) (P = 0.01). Patients with HDH had hypertension (28, 58%), bone mineral disorder (6, 13%), a combination of diabetes mellitus and hypertension (9,19%), combination of hypertension and mineral bone disorder (4,6%), and other etiologies (1,4%) as cause of CKD. There was no significant association between the etiology of ESRD and occurrence of HDH [Table 2]. Out of 48 patients with HDH, 17 (35%) developed headache during their first ever session of hemodialysis. 20 (41.2%) patients with HDH had a baseline primary headache disorder prior to diagnosis of ESRD. 28 (58.3%) patients with HDH had a de-novo headache disorder after initiation of HD for ESRD. 13 (16.25%) patients had a baseline primary headache disorder, but still did not develop HDH [Table 2].

The dialyzers used were bicarbonate based and the surface area of the dialyzer membrane was 1.3 mm², 1.5 mm² or 1.7 mm². On assessing the re-utilization of a dialyzer, it was seen that 34 (70.83%) patients having HDH were on single use dialyzers whereas 14 (29.17%) patients having HDH were on reusable dialyzers (P = 0.53). There was no significant association between presence of HDH and the surface area or characteristic of dialyzer. All participants in our study were provided with complimentary tea or coffee during the hemodialysis sessions by the hospital and so a relationship between HDH and caffeine consumption could not be studied. 41 (85%) patients in our study having HDH needed paracetamol in a dose of 500-650 mg to control their headache during the HD session, whereas 7 (15%) just took rest for remission of headache.

**DISCUSSION**

This study which was initiated to find the prevalence of HDH found that nearly one-third (37.5%) of patients with ESRD undergoing dialysis experience HDH in a tertiary care hospital.
### Table 2: Characteristics of hemodialysis Headache

| Characteristic                        | HDH Present (48) | HDH Absent (80) | P     |
|---------------------------------------|------------------|-----------------|-------|
| Sex Male n (%)                        | 18 (22)          | 64 (78)         | <0.001|
| Female n (%)                          | 30 (65)          | 16 (35)         |       |
| Age Mean (SD)                         | 47.2 (17.3)      | 51.4 (14.9)     | 0.150 |

| Etiology of ESRD                      | n (%)            | n (%)           | Total |
|---------------------------------------|------------------|-----------------|-------|
| Mineral Bone Disorder + Hypertension  | 4 (80)           | 1 (20)          | 5     |
| Diabetic Nephropathy                  | 0                | 2 (100)         | 2     |
| Hypertensive Nephrosclerosis          | 28 (33)          | 58 (67)         | 86    |
| Mineral Bone Disorder                 | 6 (67)           | 3 (33)          | 9     |
| Diabetes Mellitus + Hypertension      | 9 (38)           | 15 (62)         | 24    |
| Others                                | 1 (50)           | 1 (50)          | 2     |

| Possible Relations with HDH           | Mean (SD)        | Mean (SD)       | P     |
|---------------------------------------|------------------|-----------------|-------|
| Pre HD SBP                            | 166.16 (28)      | 163.88 (26)     | 0.642 |
| Post HD SBP                           | 156.35 (27)      | 155.91 (26)     | 0.927 |
| Pre HD DBP                            | 95.16 (22)       | 87.66 (15)      | 0.021 |
| Post HD DBP                           | 85.87 (14)       | 83.86 (17)      | 0.486 |
| Serum Creatinine                      | 7.81 (2.57)      | 7.94 (2.68)     | 0.787 |
| Serum Potassium                       | 5.11 (0.76)      | 5.6 (4.02)      | 0.409 |
| Serum Urea                            | 92.5 (30.4)      | 92.13 (36.33)   | 0.954 |
| Serum Sodium                          | 135.33 (3.85)    | 135.2 (6.54)    | 0.900 |
| Serum Albumin                         | 3.11 (0.49)      | 3.04 (0.54)     | 0.464 |
| Hemoglobin                            | 10.44 (1.57)     | 10.14 (1.9)     | 0.360 |

### Dialysis Characteristics

| Frequency Of HD                        | n (%)            | n (%)           | Total |
|---------------------------------------|------------------|-----------------|-------|
| Twice a week                          | 21 (44)          | 54 (66)         | 75    |
| Thrice a week                         | 27 (56)          | 26 (33)         | 53    |

| Duration of Hemodialysis              | n (%)            | n (%)           | Total |
|---------------------------------------|------------------|-----------------|-------|
| 3 h                                   | 1 (2)            | 0               | 1     |
| 4 h                                   | 47 (98)          | 80 (100)        | 127   |

| Dialyzer Usage                        | n (%)            | n (%)           | Total |
|---------------------------------------|------------------|-----------------|-------|
| First Use                             | 34 (71)          | 61 (76)         | 95    |
| Re-use                                | 14 (29)          | 19 (23)         | 33    |

| Possible Association                  | P                |
|---------------------------------------|------------------|
| PHQ9 Mean (SD)                        | 7.56 (4.51)      | 2.58 (1.63)     | <0.001|
| Depression Yes n (%)                  | 39 (81)          | 11 (14)         | <0.001|

| Presence of Headache Disorder at Baseline | n (%)            | n (%)           | Total |
|-------------------------------------------|------------------|-----------------|-------|
| Yes                                       | 20 (42)          | 13 (16)         | 43    |
| No                                        | 28 (58)          | 67 (84)         | 95    |

| Headache associated with First HD session| n (%)            | n (%)           | Total |
|-----------------------------------------|------------------|-----------------|-------|
| Yes                                     | 17 (35)          | 0               | 17    |

### HDH Characteristics

| Site of Headache                        | Category         | Frequency (%) |
|-----------------------------------------|------------------|---------------|
| Frontotemporal                          | 22 (46)          |
| Frontal                                 | 18 (38)          |
| Temporal                                | 3 (6)            |
| Parietal                                | 3 (6)            |
| Occipital                               | 2 (4)            |

| Time elapsed between start of HD and onset of Headache | n (%) |
|--------------------------------------------------------|-------|
| <60 min                                                | 12 (25) |
| 60-120 min                                             | 13 (27) |
| 120-180 min                                            | 10 (21) |
| >180 min                                               | 13 (27) |

Contd...
in India. Various studies have reported similar results [Table 3].[6‑8] Amongst the patients with HDH, nearly one-tenth of them started to have headaches from the first dialysis session itself. Few studies have reported that patients who developed headache during their first hemodialysis session were more susceptible to develop headache during the subsequent sessions and fulfill the ICHD 3 criteria of HDH. Patients with a previous diagnosis of a primary headache disorder showed higher risk of developing HDH.[9] In our study, nearly forty percent of the patients with HDH had a pre-existing headache disorder. It may be debatable whether a pre-existing headache disorder should be considered as a risk factor for development of HDH or whether it should be considered as a confounding variable. The ICHD classifies HDH separately as a different headache disorder based on well-defined criteria irrespective of presence or absence of pre-existing headache in the past and so we consider pre-existing headache as a risk factor for development of HDH. The common site of occurrence of headache was

| Table 2: Contd... |
|-------------------|-----------------|
| **Duration of HDH** | **n (%)** |
| <60 min | 34 (71) |
| 60-120 min | 12 (25) |
| 120-180 min | 1 (2) |
| >180 min | 1 (2) |

| **Treatment** | **n (%)** |
|--------------|-----------|
| Paracetamol | 41 (85) |
| Rest | 7 (14) |

| Table 3: Comparison of current study with other published studies on HDH |
|-------------------|-----------------|
| **Author** | **Year** | **Country** | **Sample Size** | **HDH Prevalence** | **Site** | **Duration [h]** | **Depression** | **Remarks** |
| Antoniazzi *et al.*[7] | 1998‑1999 | USA | 132 | 28 (21%) | NA | NA | NA | Only frequency assessed |
| Göksan *et al.*[6] | 1996‑2000 | Turkey | 63 | 30 (48%) | Frontotemporal (50%) | <4: 63% 4‑24: 37%. | NA | Females had more HDH. Differences in Pre and post HD blood urea were associated with HDH |
| Goksel *[et al.]*[8] | 2005 | Turkey | 250 | 70 (30%) | Vertex (41%) | 5.17±5 h | NA | Pre HD serum sodium was higher in HDH patients. Both HD and peritoneal dialysis were assessed |
| Biljana *et al.*[21] | 2014 | Serbia | 409 | 286 (70%) | bilateral | <4 h | NA | Low prevalence in this study |
| Jesus *et al.*[12] | 2009 | Brazil | 163 | 11 (6.7%) | Diffuse temporal | ≤ 4 h in 72.7% | NA | Measured association of depression amongst HD patients and Mortality |
| Farrokh *et al.*[14] | 2013 | Canada | 21055 | NA | NA | NA | HR‑1.51 (95% CI, 1.35‑1.69) | Assessed treatment effect on QOL in patients |
| Cukor *et al.*[15] | 2013 | USA | 65 | NA | NA | NA | 48.5% | Assessed treatment effect on QOL in patients |
| Current Study | 2020 | India | 128 | 48 (38%) | Frontotemporal (46%), bilateral | <1 h in 71% | 39 had depression | Assessed depression too. HDH patients had more depression. Pre‑HD BP and depression associated with HDH |

NA: not assessed/not available in the study; HDH: Hemodialysis related Headache; VAS: Visual analogue scale; USA: United States of America; HR: Hazards Ratio
bilateral fronto-temporal region (22.46%) in majority of the participants. This study also revealed that headache was observed more among women (62.5%) than men (32.5%). This finding is similar to the study by Gökşan et al., but contrasting to findings of the study conducted by Alan. We also found that the mean (SD) severity of pain on VAS was 4.54 ± 1.74 and median (Interquartile Range) was 4.5 (3.7). This was similar to other studies which also showed moderate intensity headache in a majority of patients. In our study, nearly three-fourth of patients with HDH developed headache after the first hour of the hemodialysis session. In another study, 56.6% experienced HDH in the final hour of the session. A similar finding (62%) was also observed by Antoniazzi et al., whereas Jesus et al. found that 27.3% patients experienced HDH in the final hour. We also found that most patients having HDH were suffering from mild to moderate depression compared to patients without HDH. Depression has been described to be a common comorbidity in patients with headache disorders. We had found a prevalence of depressive disorders in nearly half of patients with primary headache disorders in our outpatient neurology clinics. It may be possible that patients who are depressed are more susceptible to develop HDH which in turn worsens depression and affects quality of life. It could also be possible that having headache frequently during the dialysis may be worsening the quality of life, leading to depression. The patients who have poor scores on PHQ9 are expected to have a negative impact on their quality of life too. Similar results were obtained in other studies by Farrokhhi et al. and Cukor et al. Thus, presence of HDH may lead to depression along with poor quality of life, making it important to find strategies to reduce HDH in order to improve the QOL of patients with ESRD undergoing HD.

We analyzed factors that might be associated with the occurrence of HDH. We found a significant difference (P = 0.02) between the pre-dialysis DBP amongst the patients with HDH and without HDH. This was similar to the results of Goksan et al. except that they found significant differences in pre-dialysis SBP levels as well. Bana et al. observed that hypertensive patients with headache and concluded that headache develops only when the blood pressure decreases rapidly from very high to low levels, and does not occur in patients with raised BP. This decline in BP may trigger a mechanism similar to that of some anti-hypertensive drugs which cause headache due to dilation of cerebral blood vessels. We also analyzed if the etiology of ESRD had any association with HDH and did not find and significant relationship between these. We did not find any significant difference in the pre-dialysis serum values of creatinine, urea or electrolytes amongst patients with HDH and without HDH. Our finding is similar to the findings of Gokse et al. We also found that more than half of patients experiencing HDH were undergoing thrice a week hemodialysis session (P = 0.01). It is possible that the patients undergoing more frequent HD had more biochemical alterations and fluctuations in blood pressure with associated cerebral blood flow changes leading to headache. The possible etiological factors that might trigger the headache are the abrupt biochemical changes during the hemodialysis session, dialysis disequilibrium syndrome, fluctuations in serotonin level, changes in renin aldosterone levels, hypoxia in the brain during the session. We analyzed if the dialysis technique, dialyzer membrane and dialyzer characteristics had any association with occurrence of HDH. We found that 1.3 mm² membranes were more commonly used and the majority of patients (95, 74.2%) were on single-use dialyzers only. Amongst these, 34 (35%) patients experienced HDH. The technical aspects of dialysis did not have significant association with occurrence of HDH. Thus, the mechanisms of occurrence of HDH are myriad, multifactorial and difficult to assess or define due to multiple associated co-morbidities as confounders amongst the patients with ESRD on MHD. A recent study from Morocco suggested that renal replacement therapy like online hemodiafiltration gave superior results in terms of reduced incidence of HDH. Further studies assessing how dialysis strategies can change frequency and severity of HDH would be required. We also evaluated the different modalities of treatment used by patients for treatment of HDH. For acute pain, paracetamol was the most frequently used and was administered by the dialysis nurse during the dialysis session on an as and when required basis. A randomized controlled trial conducted by Morais et al. using non pharmacological methods like watching comedy movies during sessions showed significant improvement in depression, anxiety, and QOL in patients undergoing HD. In that trial, the patients in the experimental group also experienced less episodes of headache and hypertension during sessions. However, the trial was not specifically addressing HDH based on ICHD 3 classification. A few medications such as angiotensin-converting enzyme inhibitors, amitriptyline, magnesium substitution, chlorpromazine, botulinum toxin have been suggested as prophylactic treatment for HDH however randomized controlled trials (RCT) evaluating medicines for prophylaxis of HDH have been conducted. There are a few studies assessing the role of caffeine in prevention and treatment of HDH with the presumption that caffeine withdrawal may be one of the reasons for development of HDH. But a study that assessed HDH in patients by randomizing and allowing patients to the experimental group who received coffee with the control group who received a placebo found no evidence of decreased incidence or prevention of headaches. As the patients with HDH have ESRD, non-steroidal anti-inflammatory drugs (NSAIDs) and cyclo-oxygenase II (COX –II) inhibitors are contra-indicated in these patients. Hence focusing on RCTs to evaluate for adequate prophylactic therapy of HDH should be the next step in its management to improve quality of life of patients.

There were a few limitations in our study. We had collected details of headache in the first session of HD retrospectively in all patients and there is a possibility of recall bias in this information. Low blood values of Magnesium have been reported as a potential risk factor for HDH but we could not measure post dialysis magnesium levels in all patients and so
association between serum magnesium and HDH could not be evaluated. We could not assess the values of CGRP and substance P before and after dialysis to assess their role in the genesis of HDH because of unavailability of these tests in our region.\[20\] We wanted to evaluate if caffeine had any role in HDH but we found that all patients undergoing HD in the hospital were being served complimentary tea or coffee by the hospital during the dialysis session and so the relevance of caffeine with HDH could not be assessed in our study. Another limitation to studies on HDH is its non-specific nature, making it hard to study and correlate the different clinical characteristics with the comorbidities. This is the reason for the paucity of research on this not uncommon disorder. Our study, which is an attempt to study this common yet neglected disorder in our region, depicts a high prevalence of HDH in our patients and points to need of further research on the pathophysiology and treatment of this disorder.

**Conclusions**

Nearly one-third of patients with ESRD on MHD have HDH. It is more common in women, is associated with moderate pain and depression. The factors contributing to HDH are still not well-characterized. With increasing cases of ESRD, and with such a high prevalence of HDH amongst such patients, identifying and alleviating risk factors for HDH is of utmost importance along with a planned approach to manage HDH. Further studies with a targeted approach to assess efficacy of different postulated treatment modalities is the need of the hour.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Bana DS, Yap AU, Graham JR. Headache during hemodialysis. Headache 1972;12:1–14.
2. Headache Classification Committee of the International Headache Society (IHS). The International classification of headache disorders, 3rd edition. Cephalalgia 2018;38(1):2–211.
3. Headache Classification Committee of the International Headache Society (IHS). The International classification of headache disorders, 3rd edition (Beta version). Cephalalgia 2013;33:629–808.
4. Kelly A The minimum clinically significant difference in visual analogue scale pain score does not differ with severity of pain. Emerg Med J 2001;18:205–7.
5. Kochhar PH, Rajadhyaksha SS, Suvarna VR. Translation and validation of brief patient health questionnaire against DSM IV as a tool to diagnose major depressive disorder in Indian patients. J Postgrad Med. 2007 Apr-Jun;53(2):102-7. doi: 10.4103/0022-3859.32209. PMID: 17495375.
6. Göksan B, Karaali-savrun F, Ertan S, Savrun M. Haemodialysis-related headache. Cephalalgia 2004;24:284–7.
7. Antoniazzi AL, Bigal ME, Bordini CA, Tepper SJ, Speciali JG. Headache and hemodialysis: A prospective study. Headache 2003;43:99–102.
8. Goksel BK, Torun D, Karaca S, Karatas M, Tan M, Sezgin N, et al. Is low blood magnesium level associated with hemodialysis headache? Headache 2006;46:40–5.
9. Santos K, Martins HAL, Ribas VR, Costa Neto J, Silva WF, Valanca MM. Cefaleia relacionada a hemodiálise: História previa de cefaleia e um fator de risco. Migraneas Cefaleias. 2009;12: 112-114.
10. Antoniazzi AL, Bigal ME, Bordini CA, Speciali JG. Cefaleia relacionada à hemodiálise: análise dos possíveis fatores desencadeantes e do tratamento empregado. Arq Neuropsiquiatr 2002;60:614–8.
11. Antoniazzi AL, Bigal ME, Bordini CA, Speciali JG. Headache associated with dialysis: The International Headache Society criteria revisited. Cephalalgia 2003;23:146–9.
12. Jesus AC, Oliveira HA, Paixão MO, Fraga TP, Barreto FJ, Valença MM. Clinical description of hemodialysis headache in end-stage renal disease patients. Arq Neuropsiquiatr 2009;67:978–81.
13. Desai SD, Pandya RH. Study of psychometric comorbidity in patients with headache using a short structured clinical interview in a rural neurology clinic in Western India. J Neurolsci Rural Pract 2014;5(Suppl 1):S39-42.
14. Farrokhii F, Abedi N, Beyene J, Kurydyk P, Jassal SV. Association between depression and mortality in patients receiving long-term dialysis: A systematic review and meta-analysis. Am J Kidney Dis 2014;63:263–35.
15. Çolık D, Ver Halen N, Asher DR, Coplan JD, Weedon J, Wyka KE, et al. Psychosocial intervention improves depression, quality of life, and fluid adherence in hemodialysis. J Am Soc Nephrol 2014;25:196–206.
16. Hazim A, Adarmouch L, Eloury A, Aasfara J, Asly M, Slassi I. Hemodialysis-related headache: Still a challenge in 2020? Effect of conventional versus online hemodiafiltration from a study in Casablanca, Morocco. Artif Organs. 2021 Jun;45(6):602-607. doi: 10.1111/aor.13866. Epub 2021 Mar 10. PMID: 33326637.
17. Morais EM, Moreira PR, Winkelmann ER. Movie watching during dialysis sessions reduces depression and anxiety and improves quality of life: A randomized clinical trial. Complement Ther Med 2020;52:102488.
18. Levin M. Resident and fellow section. Headache: The Journal Of Head And Face Pain 2013;53:181–5.
19. Aoun MH, Hilal N, Beaini C, Sleilaty G, Hajal J, Boueri C, Chelala E. Effects of Caffinated and Decaffeinated Coffee on Hemodialysis-Related Headache (CoffeeHD): A Randomized Multicenter Clinical Trial. J Ren Nutr. 2021 Mar;12:S1051-2276(21)00033-9. doi: 10.1053/j.jrn.2021.01.025. Epub ahead of print. PMID: 33715955.
20. Sousa Melo E, Carrilho Aguiar F, Sampaio Rocha-Filho PA. Dialysis headache: A narrative review. Headache 2017;57:161-4.
21. Stojimirovic B, Milinkovic M, Zidverc-Trakovic J, Trbojevic-Stankovic J, Marie I, Mille M, Andric B, Nikic P. Dialysis headache in patients undergoing peritoneal dialysis and hemodialysis. Ren Fail. 2015 Mar;37(2):241–4. doi: 10.3109/0886022X.2014.982486. Epub 2014 Nov 13. PMID: 25394277.