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INCORPORATING INNOVATIVE NANOTECHNOLOGY EPILEPSY TREATING DEVICE IN NURSING MANAGEMENT OF ADULT PATIENTS WITH EPILEPSY: COVID19 PANDEMIC CONSIDERATION

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Abstract

Introduction

Epilepsy is a disease categorized by a spontaneous repetition of unprovoked seizures, is one of the most widespread chronic neurological states. the rate of its prevalence is reported to be 0.7–1.0% (Fiest, Sauro, Wiebe, Patten, Kwon & Dykeman, 2017). The Center for Disease Control and Prevention (CDC) proposes that neurological comorbidities, including epilepsy, could be a risk factor for COVID-19(Kuroda, 2020). The concern of the COVID19 pandemic toward patients with epilepsy include the fact that Frequent seizures would cause malnutrition, and the nutritional status is associated with the immune system (Crepin, Godet, Chassain, Preux&Desport, 2009). On the other hand, going to emergency rooms because of increased or uncontrollable seizures could expose the patient to coronavirus. Therefore, it's crucial to consider innovative ways to detect and control seizures among these patients.

Aim

The current study consists of two folds; the first fold focuses on the comprehensive assessmentof adult patients with epilepsy. The second fold of the study describes the innovative nanotechnology epilepsy treating device and suggesting incorporating the proposed device in the nursing management plan of patients with epilepsy.

Design

A descriptive research design was espoused in this study.

Methods

A convenience sample of 150 adult patients with epilepsy were recruited. Data collectionwas conducted at the neurology department Kasr Al-Aini University Hospital, andtwo tools were used to collect the needed data: Sociodemographic datasheet & Comprehensiveassessment sheet. The study's second fold is porposed based upon extensive litreture review and the results obtained from the first fold of the study.

Results

The majority of the studied subjects, 82%, had epilepsy for more than 5 years up to 10 years. Almost half of the studied subjects,49.3%, had 3 epileptic attacks the year before the study. Concerning post-ictal symptoms, 93.3% of the study subjects had headaches or migraines, and 52.9% experienced it severely. In addition to 86% of the studied sample felt fear and anxiety.The presence of aura or warning symptoms before seizure attacks (55.3%) of the studied subjects never had any.

Conclusion and Recommendation

The current study results highlight the critical issue of having an epileptic seizure without any warning signs, which encourages the initiation of using the proposed nanotechnology device to detect the attack before it happens. Incorporating such a device in a nursing management plan can have a magnificent prognosis of patients with epilepsy regarding control of attacks and prevent post-ictal devastating symptoms especilly that patients with epilepsy havea greater risk of COVID19 infection and subsequent morbidity and mortality.

Background

Epilepsy is a chronic non-communicable neurological disease that affects about 50 million people worldwide. Repeated seizures characterize it, transitory episodes of involuntary movement that may be partial (involve a part of the body) or generalized (affect the entire body). These episodes are sometimes accompanied by loss of consciousness and bowel or bladder incontinence (WHO, 2019).Epilepsy could be noted as a devastating disease usually associated with significantphysical and psychosocial sequelae (Bautista RED, 2017).

Epilepsy is considered as the fourth cause of neurological disability, after Migraine, Dementias, and Cerebrovascular Disease (Busto, 2014). Epilepsy was before referred to as a neurological disorder, but currently, the International League against Epilepsy (ILAE) and the International Bureau for Epilepsy (IBE) is considering it as a disease rather than a disorder (WHO, 2014).

Patients with epilepsy have been significantly affected by coronavirus pandemic COVID-19, which caused extreme societal disruption worldwide. Activities of daily living and routines have markedly changed during the pandemic for all humans. While patients with chronic disease, including epilepsy, are at unique risk for health-related disturbances. The risk of the virushaspotentially created exceptionalbarricades for people with epilepsy.

It is imperative to preserve the control of seizures, along with the prevention of COVID19. However, visits to clinics and periodic filling of prescriptions comprise the more incredible difficulty patients with epilepsy encounter in avoiding crowded situations. Previous experience with SARS evidently shows that emerging infectious diseases can potentially prevent patients with epilepsy from keeping up with their routine appointments (Lai, Hsu, Chen, 2005).

The Pan American Health Organization (PAHO), stated that epilepsy is, in sequence, a global public health problem and a clinical condition with self-effects in up to 50% of patients.As said by World Health Organization (WHO) reports, estimation of 50 to 69 million people agonize from this disease, the majority of those patients live in developing countries, in which the quality of life is inferior, and the rate of infection of the nervous system and the central nervous system (CNS) is more prominent, and it can be proclaimed that epilepsy affects 1-2% of the population (GS, Neligan& JW, 2014).

Apatient with epilepsy often has comorbidities; therefore it must carefully manage their epilepsy and comorbid diseases andcircumnavigate how their life is affected by their diseases (Miller, Bakas&Buelow,2014).Precipitating factors of epileptic seizures include fatigue, sleep deprivation, stress, illumination, non-compliance with medical treatment as well as metabolic factors, Menstruation (catamenial epilepsy), fever (infection), and hyperventilation (Hernández TL, 2017).

For many subjects with epilepsy, the ongoing social reality of their illness is considered as a stigma. Epilepsy stigma has three differentlevels; internal, interpersonal, and institutional. Whereas there have been recognized improvements in public behaviors toward epilepsy, the

leftovers of "old" ideas about epilepsy remain to inform prevalent concepts resulting in a challenging social environment for those pretentious. The social and quality of life difficulties arising from a diagnosis of epilepsy can signifymore significant challenges than are defensible by its clinical strictness. The association between stigma and diminished quality of life is well recognized (Jacoby & Austin, 2007).

Nurses play a critical role in promoting the best health outcomes for people with epilepsy by imparting information about the disease, teaching self-management skills, and discussing treatment options with patients and their families. The nurse's role, however, goes beyond that. As discoursed in part 1 of this series, epilepsy presents numerous psychosocial challenges it is a highly stigmatized, frequently misunderstood condition that may limit mobility and employment, as well as social and educational opportunities. Affected patients often accompany psychiatric or cognitive diagnoses and report having less self-efficacy for managing seizures and low health-related quality of life. In addition to teaching patients and their family members about treatments, nurses must act as advocates, helping patients find appropriate community resources, educating the public at large, and promoting positive attitudes toward people with epilepsy (Smith, Gigi, Wagner, Janelle, Edwards &Jonathan, 2015)

Nurses have become increasingly involved in overseeing the management of patient’s withcomplex medical conditions, including those with epilepsy. Nurses who are not epilepsy specialist’s canplay a central role in providing optimal care, education, and support to their patients with epilepsy, giventhe proper tools. (Buelow, Miller &Fishman, 2018).

The nurse practitioner offers a unique perspective in the early management of patients with epilepsy. A part of the health-care team, the nurse, undertakes an imperative role in providing comprehensive epilepsy care to prevent aggravating factors of seizures and post-ictal care. Epilepsy can occur at any time throughout life; therefore, age-related needs necessitate ongoing nursing assessment and intervention.

Methods

The current study consists of two folds; the first fold focuses on the comprehensive assessment of physical, cognitive, social, and behavioral needs of adult patients with epilepsy during the COVID19 pandemic. The second fold of the study describes the innovative nanotechnology epilepsy treating device and explains the nursing role in utilizing the nursing management plan device.

Study Objectives

To provide information about characteristics of adult patients with epilepsy during the coronavirus disease of 2019 (COVID-19) pandemic, therefore, providing consensus recommendations on how to provide the best possible care for people with epilepsy, especially during social isolation.Second fold aimed at utilizing the data acquired from the first part to propose nanotechnology to be utilized in the nursing management plan of adult patients with epilepsy.

The First Fold of the Study

Design

A descriptive research design was utilized in the current research.

Sample

To fulfill the aim of the first fold of the study, a purposive sample of 150 adult patients with epilepsy, their age ranged from 18 < 60 years old, diagnosed epilepsy for at least 2 years and able to comprehend and communicate and agree to participate in the study were recruited. The sample size of 150 participants was calculated using The Power analysis of .95 (β = 1-.95 = .5) at alpha .05 (one-sided) with a large effect size (0.5) was used as the significance level because this level has been suggested for use in the most areas of behavioral science research with confident level 95% (Ellis & Paul, 2010).

Setting

The first fold of study was conducted in Outpatient Clinic of neurology affiliated with Cairo University Hospital. It is one floor that is divided into 19 rooms; three rooms equipped fordiagnostic purposes, one room for assessment of weight, height, BMI, and health education. One room for storage and dispensing medications, archive room, ten rooms for patients' examination, and two significant patients were waiting halls and one lectures hall. It hosts a number of patients, about 150 Pts /day.

Tools of Data Collection

Data of the first fold of the study were collected using two tools, which were constructed by the first researcher after extensive reviewing of the recent available literature of the various aspects related to epilepsy and the consultation of the panel of five experts in the field of neurology and medical surgical nursing.

Tool I

Structured questionnaire tool that was developed by the researcher; it consists of two parts.

Demographic characteristics questionnaire, which covered the following six variables: age, gender, marital status, level of education, place of residence, and occupation.

Medical-related data questionnaire, including items like BMI, duration of epilepsy and its treatment regimen, last epileptic seizure, and family history, presence of other medical problems, and related medications.

Tool II

Comprehensive epilepsy assessment questionnaire: It was developed by the first researcher and tested for reliability. It consists of items that cover physical, social, psychological data.

Validity and Reliability

A panel of five experts revised tools of data collection in neurology and medical-surgical nursing, Cairo University. Each expert of the panel was asked to examine the instrument for content validity. Internal consistency and reliability were determined using Cronback's Alpha and demonstrated internal reliability = 0.60 and it was considered an acceptable level.

Ethical Consideration

An official permission was taken from the neurology outpatient clinic. Besides, during the phase of data collection; the investigator obtained a written informed consent from each patient who agreed to participate in this study after informing him/her about the aim of the study and emphasizing that participation in the study is entirely voluntary and that they have the right to withdraw at without giving any reason. Anonymity and confidentiality were assured through coding the data.

Results and Data Analysis

Table (1): Frequency & percentage distribution of some demographic characteristics among study subjects (n=150).

Variables	N	%	**S.D. ± X**
Age 35 < 45 years45 < 55 years55 < 65 years	56 67 27	37.344.618	46 ±3.6
Gender Male Female	4743	52.247.8	
Education Illiterate had basic education	234	1.322.7	
Secondary	16	10.7	
University or graduate studies	98	65.3	

As presented in table (1), the mean age of the studied sample was 46yrs, as regarding educational level, (65.3%) of them had university of a graduate degree.

Part two:Medical-related data.

Table (2): Frequency & percentage distribution of medical-related data among studied subjects (n=150)

Variables	N	%
Body Mass Index		
18.5-24.9	14	9.3
25-29.9	63	42
>30 & more	73	48.7
M±SD	32.38±21.37	
Duration of Epilepsy		
1<5 years	17	11.3
5<10 years10<15	12310	82 6.7

Referring to the duration of epilepsy table (2) show that the majority of the studied subjects, 82% had epilepsy for more than 5 years up to 10 years.

Table (3): Frequency & percentage distribution of the number of epileptic attacks during the last year among studied subjects (n=150).

Number of attacks	N	%
1 Attack	19	12.6
2 Attacks	38	25.3
3 Attacks 4 Attacks or more	74	49.312.6

In relation to studied subjects'number of epileptic attacks during the last year among studied subjects, table (3) showed that almost half of the studied subjects (49.3%) had 3 epileptic attacks the year before the study.

Table (4): Frequency & percentage distribution of seizure severity among studied subjects (n=150)

Toenails problems	N %	
Major seizure98 65 Minor seizure 32 21.3 Both major and minor seizures 20 13.3		

As regard seizures, severity table (4) revealed that (65%) of the studied subjects had a major seizure and while (21.3%) of them had minor seizure attacks.

Table (5): Frequency & Percentage Distribution of Epilepsy treatment among Studied Subjects (n=150)

Variables	N	%
Treatment		
Valproic acid (Depakene)	50	33.3
Lamotrigine (Lamictal)	10	6.7
Carbamazepine (Carbatrol, Tegretol, others)	60	40
Phenytoin (Dilantin, Phenytek)	30	20

It is apparent from the table (5) that (40%) of the studied subjects were treated with Carbamazepine (Carbatrol, Tegretol, others).

Table (6): Frequency & percentage distribution ofpresence of aura or warning symptoms before attacksamong studied subjects (n=150)

presence of aura or warning symptoms	N %
always28 18.6	
Usually 17 11.3 Sometimes 22 14.6 Never 83 55.3	

Regarding of presence of aura or warning symptoms before attacks, table (6) displayed that (55.3%) of the studied subjects never had aura or warning symptoms before seizure attacks.

Table (7): Frequency & percentage distribution of post-ictal symptoms among studied subjects (n=150)

Post-ictal sign and sy	N	%
1-headache or migraine		
No	10	6.6
Yes	140	93.3
Mild	21	15
Moderate	45	32.1
Severe	74	52.9
2-Fatigue		
No	17	11.3
Yes	133	88.7
3-sore muscle		
No	80	53.3
Yes	70	46.6
4-fear and anxiety		
No	21	14
Yes	129	86
5-Aggression		
No	107	71.3
Yes	43	28.7

Total is different as the patients can suffer from multiple sign and symptoms

Concerning post-ictal symptom table (7) showed that (93.3%) of the study subjects had headache or migraine, (52.9%) of them had severe headache or migraine. In addition to 86% of the studied sample felt fear and anxiety.

The Second Fold of the Study

Based on the results gained from the first fold of the study as well as an extensive review of literature an innovative nanotechnology epilepsy treating device is proposed to be incorporated in the nursing management of patients with epilepsy as described below.

Description of the Device

The proposed device will act in a more developed and accurate manner that could help prevent the seizures in the focal area, hoping to help many patients suffering.

To treat neurological disorders such as epilepsy, it is necessary to act at precisely the time and place in the brain.

By implanting a device that uses multi-level, closed loops. One system identifies and maps epileptic networks; Another predicts epileptic seizure onsets, a third system allows the device to distinguish seizure severity to deliver the appropriate dosage and adjust other treatment parameters and a system for following up on how the device work and to control it through a wireless mechanism and to be able to be recharged through a wireless link.Lastly, another system incorporates these inputs to optimize and adjust the device parameters and therapeutic doses.

This device for epilepsy directly targets the brain areas that cause seizures .looking into the possibility of combining the treatment with an implantable device that measures brain activity, which would allow creating an implanted and autonomous treatment that activates itself and injects the drug right before a seizure occurs.The treatment uses an electronic micropump and an antiepileptic drug tohinder the brain's relevant areas without upsetting healthy brainregions.

A sensor is utilized to detect a seizure or resulting from the onset of a seizure. A system that identifies patterns of electrical actionsimilar to a template developed from recording an actual seizure. Following identification of neural activity that suggests the onset of a seizure, Infusion (containing antiepileptic drugs: GABA or other antiepileptic drugs) can be applied for a time through closed-loop (negativefeedback).

If the Infusion is suitable to suppress the neural activity, thereby preventing the onset of the seizure, the Infusion will stop after time has elapsed or changed in the signal detected by thesensor .If, on the other hand, the sensor's neurological activity indicates potential seizure activity is not being suppressed, then Infusion and stimulation can be both be applied for the time to suppress the seizure. Infusion and stimulation would be terminated after some time has elapsed or after an appropriate change of the sensor's signal that back to normal.

By using a microprocessor or Nano processor that can control dose release according to the severity of the seizure through detection how much Amplitude and magnitude of the incoming electrical signal is different from the normal by the programed sensor .this device will act through the wireless mechanism between the sensor and the processor and the pump(with a battery as an energy source) and through the signal power and magnitude from the sensor that arrives, the processor will determine the dose and then, will send a signal to release the antiepileptic drug with determined dose from the micropump .The pump will comprise a pharmacotherapy-filled reservoir(containing cannabinoids or antiepileptic drugs) in

communication with a catheter (a proximal end in fluid communication with a pump and a discharge portion for infusing a dosage of the drug)to make sure the delivery of the drug to the appropriate area.The sensor will be programmed on a sample of an EEG signal (or other physiological signals), and any increase in the incoming signal will activate the device.

The device could have a micro or a Nano memory to store EEG waveforms, parameters, or logs of actions taken from it. It could be connected to a program through a wireless link to download or receive data (including stored EEG waveforms, parameters, or logs of actions taken) from the device to the program or Upload, transmit program code to the device in order to perform specific actions or change modes desired by a physician operating the program .this system will provide the patient the ability to control the device if any need to switch on or to switch off through accessing the program as it presents in Similar devicesfor manual and automatic activation of the implantable medical devices that are known.

The program will be adapted to receive physician input and provide physician data that will be transmitted between the program and the device over the wireless link to facilitate these functions. The program may be coupled via a communication link. A network wasconnecting the Internet. This permitsany information downloaded from the device as well as any program code or other information to be uploaded to the device to be stored in a database at one or more data repository locations.This would allow the patient (and the patient's physician) to accessessential data, including past frequency seizures, dose released from the device, and software updates.

The battery in the implantable device should last at least several years. This device's batteries could be rechargeable through a wireless monitoring system for the battery state, then transmitting the proper amount of power over a wireless link from an energy source.

Conclusion and Recommendation

Epilepsy is one of the furthermost devastating neurological diseases physically, socially, and psychologically. Most of the patients in the current study didn't experience any warning signs before attacks. Patients experienced physical fatigue, pain, and trauma, in addition to emotional distress and social isolation. One of the main goals of nursing management of patients with epilepsy is to prevent trauma and other devastating symptoms of an epileptic seizure. It is crucial to focus on preventing seizure attacks. Using the proposed nanotechnology treating device will help in detecting the seizure before it happens. It gives a chance to control and manage attacks

efficiently.Incorporating such a device in a nursing management plan can have a magnificent prognosis of patients with epilepsy regarding control of attacks and prevent post-ictal devastating symptoms especilly that patients with epilepsy havea greater risk of COVID19 infection and subsequent morbidity and mortality.

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