EFFECTS OF INTERFERENTIAL THERAPY ON SELECTED CARDIOPULMONARY PARAMETERS, ASTHMA CONTROL AND QUALITY OF LIFE OF PEOPLE LIVING WITH ASTHMA

EFFECTUL TERAPIEI INTERFERENȚIALE ASUPRA PARAMETRILOR CARDIOPULMONARI SELECTAȚI, CONTROLUL ASTMULUI ȘI CALITATEA VIEȚII PACIENȚILOR CU ASTM

Happiness A. Aweto[1], B.A. Tella[2], Eniola O. Awolola[3]

Keywords: Interferential therapy, Asthma, Cardiopulmonary, Asthma control test, Quality of life

Cuvinte cheie: terapie interferențială, astm, cardiopulmonar, test de control al astmului, calitatea vieții

Background
The introduction of pharmacological interventions for the control of asthma symptoms has resulted in declined interest in non-pharmacological methods despite their usefulness. This study investigated the effects of interferential therapy (IFT) on selected cardiopulmonary parameters, asthma control and quality of life in people living with asthma.
Method: Forty-seven individuals with asthma recruited from the Respiratory clinic of the Lagos State University Teaching Hospital, Ikeja were randomly assigned to two groups. Group A (23 participants) was the intervention group that received IFT for 20 minutes per session, three times a week for six weeks as well as weekly counseling sessions on bronchial asthma while Group B was the control group (24 participants) that received weekly counseling sessions only. Forty two participants completed the study. Selected cardiopulmonary parameters, Asthma control test (ACT) and Asthma quality of life questionnaire (AQLQ) were assessed at baseline, 2nd, 4th and 6th weeks. Data was analyzed using SPSS version 17.
Results: There was significant improvement in the systolic blood pressure of group A (p=0.004). Group A also had significant improvements (increases) in Forced Expiratory Volume in one second (p=0.02), Forced Vital Capacity (p=0.04) and Peak expiratory flow rate (p=0.007) while group B had significant reductions in these pulmonary parameters. There were significant improvements (increases) in the ACT score (p=0.0001) and AQLQ (p=0.001) of group A and a significant reduction in ACT score of group B.
Conclusion: Inteferential therapy brought about significant improvements in most of the selected pulmonary parameters, ACT score and AQLQ score of people living with asthma.

Introducere
Introducerea intervenției farmacologice pentru controlul simptomelor astmului a dus la reducerea interesului față de metodele nonfarmacologice, în ciuda utilității acestora. Acest studiu dorește să urmărească efectele terapiei interferențiale (IFT) asupra parametrilor cardiopulmonari selectați, controlului astmului și a calității vieții, la persoanele cu astm.
Metode: Patruzeci şi şapte de subiceți cu astm selectați din cadrul Clinicii Respiratorii a Lagos State University Teaching Hospital, Ikeja au fost distribuiți aleatoriu în două grupuri. Grupul A (23 participanți) a constituit grupul experimental și a primit IFT timp de 20 minute pe ședință, de 3 ori pe săptămână, timp de 6 săptămâni, consiliere săptămânală privind astmul bronșic, în timp ce Grupul B a constituit grupul de control (24 participanți) care a primit doar consiliere săptămânală. Patruzeci și doi de participanți au terminat studiul. Parametrii cardiopulmonari selectați testul de control al astmului (ACT) și chestionarul de calitatea vieții pacientului cu astm (AQLQ) au fost folosite la evaluarea inițială, apoi la 2, 4 și 6 săptămâni. Pentru analiza statistică s-a folosit SPSS versiunea 17.
Rezultate: A existat o îmbunătățire semnificativă a tensiunii arteriale sistolice la grupul A (p=0.004). De asemenea, grupul A a prezentat îmbunătățiri semnificative (creșteri) a expirului forțat într-o secundă (p=0.02), capacitatea vitală forțată (p=0.04) și rata respiratorie (p=0.007), în timp de grupul B a prezentat o reducere semnificativă în reducerea a parametrilor pulmonari. Au existat creșteri semnificative în scorul ACT (p=0.0001) și AQLQ (p=0.001) a grupului A și o reducere semnificativă a scorului a scorului ACT a grupului B.
Concluzii: Terapia inteferențială a adus îmbunătățiri semnificative în majoritatea parametrilor pulmonari selectați, scorul ACT și AQLQ, la persoanele cu astm.

[1] Lecturer
[2] Senior Lecturer, Department of physiotherapy, College of Medicine, University of Lagos, PMB 12003, Idi-Araba, Lagos state;
[3] Physiotherapist, Lagos state University Teaching Hospital, Ikeja, Nigeria.
Corresponding author: *Happiness Anulika Aweto, +234 -8028964385
E-mail: awetohappiness@gmail.com or haweto@unilag.edu.ng

Introduction

Globally, asthma affects about 300 million people around the world and its prevalence is variable [1,2]. It is a disease that has been observed to be more prevalent in developed countries [1]. In Nigeria, the prevalence of asthma ranges from 7% to 18% of the general population [3-5]. Asthma prevalence is increasing despite recent advances being made in its management and about 250,000 people die from it every year [2,6,7]. Enormous advances have been made in the understanding and management of asthma in the past 20 years. These include understanding the inflammatory nature of the disease, use of steroids, use of long acting bronchodilators, use of devices to deliver the medications more appropriately/conveniently and appreciation of the value of self-management education [1,7,8].

Treatment of asthma involves controlling triggering factors, drug therapy and other non-pharmacological methods. Since the introduction of pharmacological interventions for the control of asthma symptoms, interest in non-pharmacological methods had declined despite their usefulness [9]. For many years, the effectiveness of asthma medications have been assessed by measuring their impact on conventional clinical outcomes such as expiratory flow rates, symptoms, the need for other medications and airway responsiveness [10]. Few studies have been conducted to investigate the effects of interferential low frequency current and other current modes on different parameters of patients with bronchial asthma [11-14].

Interferential therapy is the application of two medium frequency currents to the skin in such a way that they "interfere" with each other to produce a "beat" frequency [15-17]. This beat frequency is the difference between the medium frequency currents. The body recognizes it as the required low frequency current. The importance of using low frequencies is that it has been shown that the body itself produces low frequency currents which are between 1 and 256 Hz [15]. Different systems in the body produce different frequencies and these can be picked up by electrocardiography (ECG), electromyography (EMG), and electroencephalography (EEG). By using specific frequencies and frequency ranges, the different systems can be stimulated and activated. Interferential Therapy has been shown to be a valuable treatment system for many years [15]. It is a simple and non-invasive treatment often used to induce analgesia, elicit muscle contractions and reduce oedema [16,18-20]. It induces expectoration by making sputum on the surface of the bronchi mobile and improves pulmonary parameters [11]. It reduces shoulder stiffness, muscular fatigue and myalgia in the chest and upper back regions [11].

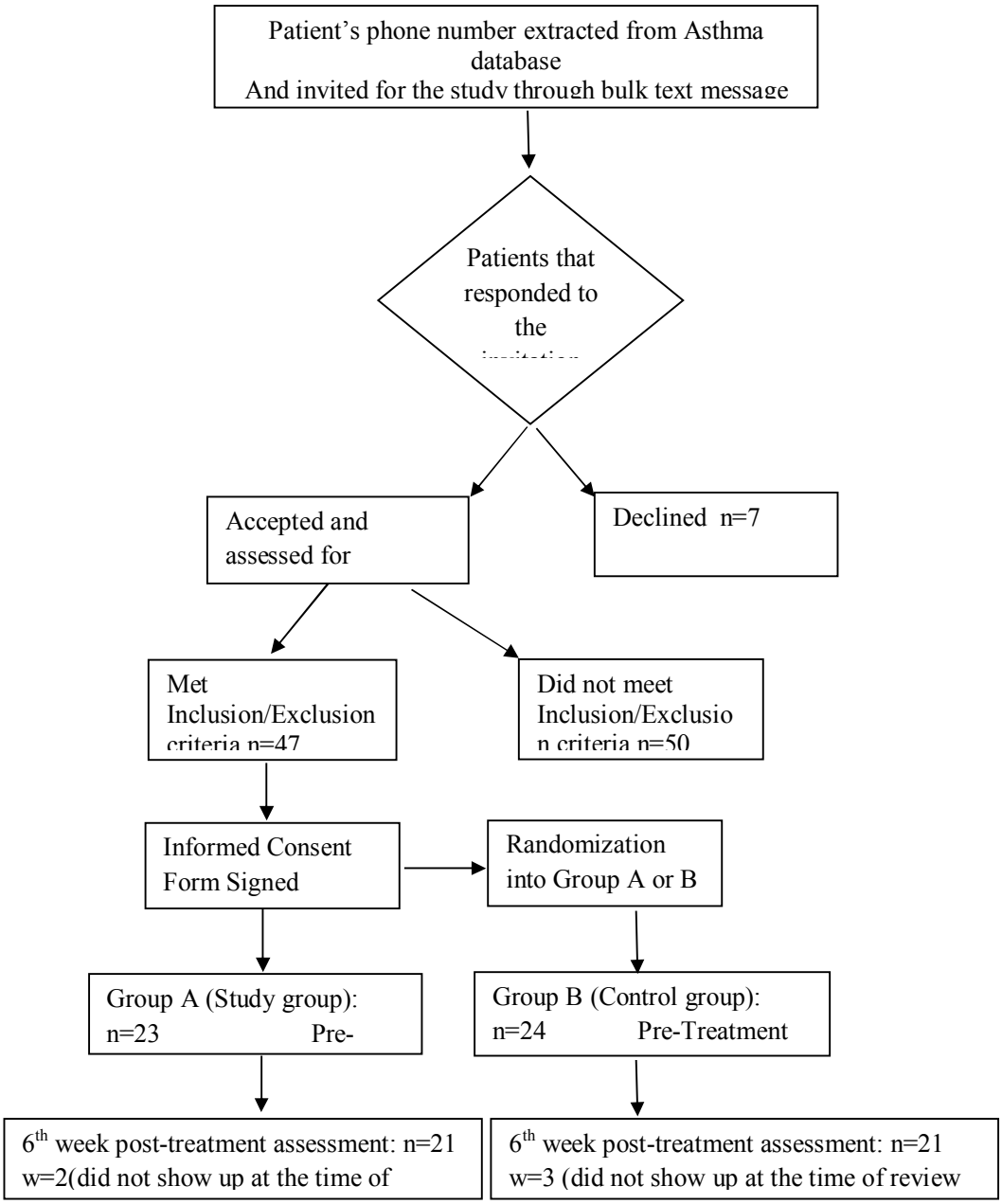
Although few studies have investigated the effects of low frequency currents on some parameters in patients with bronchial asthma, not much is known on the effects of IFT on selected cardiopulmonary variables, asthma control and quality of life of patients with asthma. Thus this study investigated the effects of IFT on selected cardiopulmonary parameters, asthma control and quality of life of patients with asthma.

Method

Participants Selection

Two hundred and twelve (212) patients with bronchial asthma attending Respiratory Clinic at the Lagos State University Teaching Hospital (LASUTH), Ikeja were invited over the phone to participate in the study but only 104 of them responded to the invitation. Ninety seven (97) patients accepted to participate in the study while the remaining seven (7) patients declined due to constraint of work. They were subsequently assessed for eligibility based on the inclusion and exclusion criteria of study. Included into the study were patients diagnosed with asthma according to GINA guidelines, who had not smoked for at least one year prior to the study, who were clinically stable and were without acute exacerbation of asthma or respiratory tract infection in the preceding 6 weeks, patients who were aged 15 years and above. Excluded from the study were patients whose diagnosis of asthma were uncertain, those with very severe asthma and whose condition would constitute a considerable risk if they exercised, those with other lung and cardiac diseases and patients with contra-indications to exercise. Forty seven patients who met the inclusion and exclusion criteria signed the written informed consent form and were

randomly assigned to two groups (A and B) using the fish bowl technique. Group A (23 patients) was the intervention group while Group B (24 patients) was the control group (Figure 1). Ethical approval was obtained from the Health Research and Ethics Committee of Lagos State University Teaching Hospital (LASUTH), Ikeja, Lagos state, Nigeria (REF. NO: NHREC04/04/2008).



KEY: n=Sample, P=Participants W=withdrawal

Figure 1: Recruitment and Randomization of Participants

Procedure for data collection

The baseline measurements of all the selected cardiopulmonary outcome parameters were taken for all the subjects after a rest period of 15 minutes prior to the intervention. Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV_1) and Peak expiratory flow rate (PEFR) were measured using a spirometer (CONTEC SP10, Model No: JE1405100271, China).

Respiratory rate in beats per minute was assessed for each participant in sitting position using a stop watch. The systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured with a mercury sphygmomanometer and a stethoscope (Lithman) in sitting position, heart rate (HR) with a stethoscope. The Asthma Control Test questionnaire (ACTQ) and Asthma quality of life questionnaire (AQOLQ) were also completed by all the participants at baseline.

All the outcome measures were also assessed at the end of the 2^{nd} week, 4^{th} week and 6^{th} week of the study for the two groups. An Interferential unit "Solo Multidyne 965" with a base frequency of 4,000 Hz was used for the study intervention in group A.

Intervention

The participants in Group A received interferential therapy. They were placed in a half lying position. Two electrodes were positioned over the upper limits of the trapezius bilaterally on the upper back, and the other two electrodes were placed anteriorly over the lower ribs [21]. Using a 4,000 Hz base current, the interferential current range was set from 10 to 150 Hz and participants received the therapy for 20 minutes per session, three times a week for six weeks. They also received group educational counseling on bronchial asthma once a week while Group B received only group educational counseling on bronchial asthma once a week.

Data Analysis

The Statistical Package for Social Sciences (SPSS Inc, Chicago, II) version 17 was used to analyze data. Descriptive statistic of mean, standard deviation and frequency were used to summarize the results. Repeated measure analysis of variance (ANOVA) was used to determine the statistical significance of the cardiovascular, pulmonary, asthma control test (ACT) score, and standardized asthma quality of life questionnaire (AQLQ) score across the baseline, end of 2^{nd}, 4^{th} and 6^{th} weeks of each group while independent t-test was used to compare the outcome variables across the two groups. The level of significance was set at $p \leq 0.05$.

Results

Out of the 47 participants that started the study, only 42 participants (22 males and 20 females) completed the study with 21 participants in each group. Each group had 11 males and 10 females respectively. Two participants from group A and three participants from group B dropped out at the 4^{th} week of study for reasons such as inflexible office schedule, ill health, high work demand, far distance of study location from their homes and out of station travel during the period of study.

The mean ages of the study and control groups were 44.05 ± 16.37 years and 38.38 ± 13.70 years respectively while the mean body weights were 71.29 ± 17.84 Kg and 79.52 ± 21.67 Kg respectively. Comparison of the baseline data of the study group with that of the control group showed that there was no significant difference (Table 1). This shows that the participants in the two groups were similar and comparable.

Table 1: Comparison between baseline data of the study and control groups

	Study group(A)	Control group(B)		
Variables	Mean ± SD	Mean ± SD	p value	
Age (years)	44.05 ± 16.37	38.38 ±13.70		0.53
Height (cm)	163.00 ±7.73	167.67 ± 8.92		0.14
Weight (kg)	71.29 ±17.84	79.52 ± 21.67	0.61	
Forced Vital Capacity ((litres)	1.84 ± 0.76	2.19 ± 0.66	0.12	
Forced Expiratory Flow in one sec ((litres)	1.50 ± 0.54	1.89 ± 0.57	0.63	
Peak Expiratory Flow (litres/min)				
Respiratory Rate (breaths/min)				
Systolic blood pressure (mm/Hg)	3.33 ± 1.49	4.28 ± 1.32	0.69	
Diastolic blood pressure (mm/Hg)	23.14 ± 4.45	20.00 ± 3.70	0.35	
Heart rate (beats/min)	126.24 ± 12.38	120.10 ± 12.81	0.96	
Asthma Control Test (ACT) Score	80.52 ± 10.57	75.81 ± 10.33	0.82	
Asthma Quality of Life Questionnaire (AQLQ) Score	76.43 ± 13.87	76.95 ± 11.62	0.72	
	15.83 ± 4.15	17.33 ± 3.54	0.22	
	4.09 ± 0.92	4.41 ± 1.12	0.23	

Comparison of the mean scores of the cardiovascular parameters of the two groups across baseline, end of 2nd, 4th and 6th week of the study using repeated measure ANOVA showed significant reduction of the SBP of group A. Post hoc analysis showed that the significant reduction in SBP occurred between baseline and the end of 2nd week as well as baseline and the end of 6th week (Table 2).

Table 2: Comparison of cardiovascular parameters of the two groups across six weeks of study

Variable	Baseline Mean±SD (a)	2nd week Mean±SD (b)	4th week Mean±SD (c)	6th week Mean±SD (d)	F	p-value	Post Hoc
Group A							
SBP	126.24±12.38	119.52±12.84	119.14±16.68	117.89±15.48	6.570	0.004*	a&b, a&d
DBP	80.52±10.57	76.19±12.44	75.43±10.04	74.21±9.61	1.421	0.273	
HR	76.43±13.87	76.24±10.08	75.10±8.54	74.74±7.87	0.502	0.686	
Group B							
SBP	120.10±12.81	121.86±16.98	119.29±15.02	121.67±16.98	0.53	0.67	
DBP	75.81±10.33	76.14±9.13	74.52±10.94	77.14±8.45	1.31	0.302	
HR	76.95±11.62	75.38±12.52	74.57±9.80	75.38±9.67	2.89	0.064	

*Significance at p<0.05

Key:

SBP: Systolic Blood Pressure

DBP: Diastolic Blood Pressure

HR: Heart rate

Comparison of the mean scores of the pulmonary parameters of the two groups across baseline, end of 2nd, 4th and 6th week of the study using repeated measure ANOVA showed significant changes in the FEV_1, FVC and PEFR of the two groups. While there were significant improvements in group A, group B had significant decrease in these parameters. Post hoc analysis showed that the significant improvement in FEV_1, FVC and PEFR of group A occurred between baseline and the end of 2nd, 4th and 6th weeks respectively; between end of 2nd and 4th weeks, end of 2nd and 6th weeks as well as end of 4th and 6th weeks (Table 3).

Comparison of the mean scores of the ACT and AQLQ of the two groups across baseline, end of 2nd, 4th and 6th week of the study using repeated measure ANOVA showed significant (increases) improvements in the ACT and AQLQ scores of group A and a significant reduction in ACT score of group B. Post hoc analysis showed that the significant improvement in ACT and AQLQ scores of group A occurred between baseline and the end of 2nd, 4th and 6th weeks respectively; between end of 2nd and 4th weeks, end of 2nd and 6th weeks as well as end of 4th and 6th weeks (Table 4).

Table 3: Comparison of pulmonary parameters of the two groups across six weeks of study

Variable	Baseline Mean±SD (a)	2nd week Mean±SD (b)	4th week Mean±SD (c)	6th week Mean±SD (d)	F	p-value	Post Hoc
Group A							
RR	23.14±4.45	21.62±5.13	21.14±4.36	19.94±2.07	3.01	0.061	
FEV_1	1.50±0.54	1.64±0.60	1.83±0.65	1.90±0.77	4.39	0.02*	a&b,a&c,a&d,b&c,b&d,c&d
FVC	1.84±0.76	2.08±0.72	2.17±0.74	2.23±0.82	2.49	0.04*	a&b,a&c,a&d,b&c,b&d,c&d
PEFR	3.33±1.49	3.71±1.47	4.38±1.69	4.12±1.64	5.80	0.007*	a&b,a&c,a&d,b&c,b&d,c&d
Group B							
RR	20.00±3.70	19.48±3.17	18.76±1.92	18.33±1.83	1.78	0.187	
FEV_1	1.89±0.57	1.76±0.57	1.61±0.50	1.51±0.50	13.57	0.0001*	
FVC	2.19±0.66	2.04±0.58	1.89±0.61	1.81±0.63	7.762	0.002*	
PEFR	4.28±1.32	4.03±1.20	3.63±1.19	3.54±1.25	1.47	0.001*	

*Significance at $p<0.05$

Key:

RR: Respiratory rate

FEV_1: Forced Expiratory Volume in one second

FVC: Forced Vital Capacity

PEFR: Peak Expiratory Flow Rate

Table 4: Comparison of ACT and AQLQ variables of the two groups across six weeks of study

Variable	Baseline Mean±SD	2nd week Mean±SD	4th week Mean±SD	6th week Mean±SD	F	p-value	Post Hoc
Group A							
ACT	15.83±4.15	16.81±4.10	17.92±3.82	17.75±4.15	25.405	0.0001*	a&b,a&c,a&d,b&c,b&d,c&d
AQLQ	4.09±0.92	4.62±0.94	5.13±0.83	5.39±0.83	8.286	0.001*	a&b,a&c,a&d,b&c,b&d,c&d
Group B							
ACT	17.33±3.54	16.52±4.41	16.67±4.12	15.62±3.81	4.836	0.012*	
AQLQ	4.41±1.12	4.64±1.29	4.51±1.29	4.38±1.27	1.381	0.281	

*Significance at $p<0.05$

Key:

ACT: Asthma Control Test

AQLQ: Asthma Quality of Life Questionnaire

Discussion

The aim of this study was to determine the effects of interferential therapy on selected cardiopulmonary parameters, asthma control and quality of life of people living with asthma.

The result showed that only the SBP of group A had significant reduction of all the selected cardiovascular parameters of the two groups. For the selected pulmonary parameters, group A had significant increases (improvements) in FEV_1, FVC and PEFR while group B had significant reductions in the same parameters. There were significant increases (improvements) in the ACT score and AQLQ of group A but a significant reduction in ACT score of group B.

The finding that IFT brought about significant improvements in most of the selected pulmonary parameters in people living with asthma implies that IFT is effective in the management of asthma. The post hoc analysis showed that the significant improvements in these selected pulmonary parameters brought about by IFT occurred as early as the 2nd week of the study and continued till the end of the 6th week. It has been shown that different systems in the body produce different low frequency currents and by using specific frequencies and frequency ranges such as Interferential frequency currents, the different systems can be stimulated and activated [15]. Interferential therapy induces expectoration by making sputum on the surface of the bronchi mobile and also reduces oedema [16,20]. Shuto *et al.* [11] reported a significant improvement in FEV_1, PEFR, RR and subjective symptoms 147 times (98.7%) following the application of Interferential low frequency therapy (IFLFT) on 46 bronchial Asthma patients.

They also reported that IFLFT reduces shoulder stiffness, muscular fatigue and myalgia in the chest and upper back regions of the patients. They observed no abnormal changes in the ECG, blood pressure and pulse rate of the patients. Sadlonova *et al*. [22] reported that pulsatile electromagnetic field brought about significant improvements of about 70ml in FVC, 80ml in FEV_1 and 480ml in PEFR of children with bronchial asthma. They also observed that the clinical status and the moods of the participants became better. Karashurov *et al.* [14] observed that implanted programmed electrostimulators into the sinocarotid nerves of 78 patients with bronchial asthma were effective in arresting and preventing the majority of asphyxia attacks, reducing the frequency of attacks and the need for medicines. They concluded that electrostimulation of the sinocarotid nerves can be applied in patients with bronchial asthma resistant to drug therapy and those who react adversely to glucocorticosteroids and adrenomimetic drugs.

The finding that there were significant increase in the ACT and AQLQ scores of group A and a significant reduction in ACT score of group B imply that IFT is effective in controlling Asthma attacks and improving the quality of life of people living with Asthma. The post hoc analysis showed that the significant improvements in the ACT and AQLQ scores of group A occurred as early as the 2nd week of the study and continued till the end of the 6th week. Ozoh *et al.* [23] observed a positive correlation between the ACT score and the FEV_1 in Nigerians with bronchial asthma. This indicates that as the FEV_1 of people with bronchial asthma increases, the ACT score increases. Therefore since IFT brought about significant improvement in the FEV_1 of people living with asthma in this study, it also led to the significant improvement in their ACT score. This may be buttressed by the post hoc analysis results of FEV_1 and ACT scores of those treated with IFT which showed that both parameters started improving significantly as early as the 2nd week of the study and continued till the end of the 6th week.

Conclusion

Inteferential therapy brought about significant improvements in most of the selected pulmonary parameters, ACT and AQLQ scores of people living with asthma. However, it had no significant effect on most of the cardiovascular parameters.

Recommendation

Based on the findings of this study, it is recommended that Inteferential therapy should be used in the management of bronchial asthma.

Conflict of Interest: None declared.

Authors' Contribution: HAA performed review of literature, interpretation of data and drafted the manuscript; BAT designed and coordinated the study and reviewed the manuscript; EOA collected data and performed the statistical analysis.

References

[1] Masoli M, Fabian D, Holt S, Beasley R. (2004) Global Initiative for Asthma (GINA) Program. The global burden of asthma: Executive summary of the GINA Dissemination Committee report. *Allergy*; 59:469–478.

[2] *** (2012) *Global Strategy for Asthma Management and Prevention*. Global Initiative for Asthma (GINA). http://www.ginasthma.org. Accessed on the 14/09/14.

[3] Ibe CC, Ele UP. (2002) Prevalence of bronchial asthma among adolescents in Anambra State, Nigeria. *Nigeria Journal of International Medicine*; 5:23–26.

[4] Erhabor GE, Agbroko SO, Bamigboye P, Awopeju OF. (2006) Prevalence of asthma symptoms among university students 15 to 35 years of age in Obafemi Awolowo University, Ile-Ife, Osun State. *Journal of asthma*; 43:161–164.

[5] Desalu OO, Oluboyo PO, Salami AK. (2009) The prevalence of bronchial asthma among adults in Ilorin, Nigeria. *African Journal of Medicine and Medical Sciences*; 38:149–154.

[6] Partridge MR. (2007) Asthma: 1987-2007. What have we achieved and what are the persisting challenges? *Primary Care Respiration Journal*; 16:145–148.
[7] Oni AO, Erhabor GE, Egbagbe EE. (2010) The prevalence, management and burden of asthma-a Nigerian study. *Iran Journal of Allergy and Asthma Immunol*ogy; 9:35–41.
[8] Saleh JA. Combination therapy in asthma. A review. *Nigeria Journal of Medicine* 2008; 17:238–243.
[9] Sullivan S D, Wenzel S E, Bresnahan B W, Zheng B, Lee J H, Pritchard M, Kamath T V, Weiss S T, (2007) TENOR Study Group. Association of control and risk of severe asthma-related events in severe or difficult-to-treat asthma patients. *Allergy*; 62: 655–660.
[10] Juniper EF, Guyatt GH, Epstein RS, Ferrie PJ, Jaeschke R, Hiller TK. (1992) Evaluation of impairment of Health-related quality of life in Asthma: development of questionnaire for use in clinical trials. *Thorax*; 47:76-83.
[11] Shuto H, K Nakagami, H Suzuki, E Noguchi (1986) Low-frequency interference in bronchial asthma. *Japanese Journal of Allergology*; 35(12), 1170-1180.
[12] Karashurov SE, Karashurov ES. Electrostimulation of the diaphragmatic muscle in bronchial asthma patients. *Klinicheskaia Meditsina journal (Mosk)* 1995; 73(1):46-47.
[13] Bykova MV, Bogoliubov VM, Reutova VS. (1996) The effect of interference currents on bronchial patency and bronchial hyperreactivity in children with bronchial asthma *Vopr Kurortol Fizioter Lech Fiz Kult* 1996; 2:15-18.
[14] Karashurov SE, Gudovskiĭ LM, Pozdnikina OIu. (2001) Electrostimulation in the therapy of bronchial asthma, Klinicheskaia Meditsina journal (Mosk); 79(11): 39-41.
[15] Emberson W. (1999) Asthma Interferential Therapy and Chartered Physiotherapy. listed in asthma, originally published in issue 36 - January 1999. Available @ www.positivehealth.com. Accesssed on 12/07/2014.
[16] Jarit GJ, Mohr KJ, Waller R, Glousman RE. (2003) The effects of home interferential therapy on post-operative pain, edema, and range of motion of the knee. *Clinical Journal of Sport Medicine*; 13:16-20.
[17] Fuentes JP, Armijo Olivo S, Magee DJ, Gross DP. (2010) Effectiveness of interferential current therapy in the management of musculoskeletal pain: a systematic review and meta-analysis. *Physical Therapy*; 90:1219-1238.
[18] McManus FJ, Ward AR, Robertson VJ. (2006) The analgesic effects of interferential therapy on two experimental pain models: cold and mechanically induced pain. *Physiotherapy*; 92:95-102.
[19] Ozcan J, Ward AR, Robertson VJ. A comparison of true and premodulated interferential currents. *Archives of Physical Medicine and Rehabilitation* 2004; 85:409-415.
[20] Goats GC (1990) Interferential current therapy. *British Journal of Sports Medicine*; 24: 87-92.
[21]Vincent Davis (1992) Management of Asthma. *Dynamic Chiropractic journal*; 10: 7.
[22] Sadlonova J, Korpas J, Kudlicka J. (2003) The effect of the pulsatile electromagnetic field in children suffering from bronchial asthma, *Acta Physiological Hungarica*; 90(4): 327-334.
[23] Ozoh OB, Bandele EO (2010) Chukwu CC. Correlation between the Asthma Control Test score and FEV_1 in Nigerians with bronchial asthma (Abstract). *Chest*; 138: 146A.