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Effect of Hypertension and atherosclerotic problems on carbothera therapy to treat diabetic foot

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Abstract:

Introduction: The term diabetes mellitus describes a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and proteinmetabolism resulting from defects in insulin secretion, insulinaction, or both. People with diabetes are at increased risk of peripheral arterial disease and neuropathy, as well as having a higher risk of developing infections and decreased ability to clear infections. Therefore, people with diabetes are prone to frequent and often severe foot problems and a relatively high risk of infection, gangrene andamputation. Now adays we use a new modality to treat diabetic foot which called carbothera which is soda-spa refers to the warm water that dissolves carbon dioxide, another name for it is Soda Bath.Our aim of this study is to discuss if there is any effect of hypertension and other atherosclerotic problems as coronary heart diseases and cerebrovascular accident in the treatment of diabetic foot by carbothera therapy.

Patients and methods: 800 patients were included in this study, all were chosen from diabetic centerrandomly, exclusion criteria was implemented for patients with,burn and fungal infection and those patients that use carbothera for neuropathy only. Age, sex, occupation, type of therapy, duration of disease and number of sessions of carbothera therapy all were taken in consideration and the age of the patients was ranging from 7 to 82, all of them underwent investigations in form of random blood sugar, glycosuria, renal function test, HbA1c…the instrument was used is auto analyzer, and specific type of kits.

Conclusion: In our study we found that presence of hypertension and other atherosclerotic problems like ischemic heart disease or cerebrovascular problems in addition to DM doesn't affect number of sessions in carbothera therapy that used for diabetic foot.

تاثير ارتفاع الضغط الدموي وعوامل تصالب الشرايين على علاج الكاربوثيرا في قدم مرضى السكري

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الخلاصة:

المقدمة: مرض السكري..هو خلل ايضي ناتج عن أسباب مختلفة يتميز بارتفاع مزمن في مستوى السكر بالدم مع اضطراب في ايض الكاربوهيدرات,الدهون والبروتينات ينتج عن خلل في إفراز الأنسولين,عمل الانسولين او كلاهما. مرضى السكري معرضون الى زيادة مخاطر الاصابه بأمراض ألاوعيه الدموية ألمحيطيه والأعصاب المحيطيه. كذلك معرضون لخطر الاصابه بالعدوى اكثر من غيرهم وتقل قدرتهم على التخلص من هذه العدوى,لذلك مرضى السكري معرضون لمشاكل القدم بصوره متكررة وشديدة , ونسبيا اكثر عرضه للاصابه بالعدوى,غنغرينا وبتر القدم. في يومنا هذا ,اصبحنا نستخدم تقنيه جديده لمعالجة قدم مرضى السكري والذي يدعى كاربوثيرا..والذي هو عباره عن حمام صودا (ماء دافئ يذيب ثاني اوكسيد الكاربون).

المرضى والطرق : في بحثنا هذا استخدمنا ٨٠٠ مريض اخترناهم من مركز السكري في محافظة ذي قار بشكل عشوائي استثنينا منهم الاشخاص الذين يستخدمون الكابوثيرالعلاج التهاب الأعصاب المحيطيه, الحروق والعدوى الفطريه. المرضى كانو من كلا الجنسين اعمارهم تتراوح من ٧ الى ٨٢ سنه كلهم

خضعوا لفحوصات متعدده مثل فحص السكرونسبة الدهون كاملة بالاضافة الى وظائف الكليتين وتخطيط القلب وفحوصات اخرى وباستخدام اجهزه متنوعه.استخدمنا برامج احصائية مثل اس بي اس اس.

النتائج المستخلصة: في هذه الدراسه وجدنا ان وجود ار تفاع الضغط الدموي او امراض تصالب الشرايين مثل جلطة القلب او الدماغ مع مرض السكري ليس لها تاثير على علاج الكاربوثيرا في قرحة القدم الناتج من مرض السكري.

Introduction

Definition

The term diabetes mellitus describes a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both(1). The effects of diabetes mellitus include long term damage, dysfunction and failure of various organs. Diabetes mellitus may present with characteristic symptoms such as thirst, polyuria, blurring of vision, and weight loss. In its most severe forms, ketoacidosis or a non–ketotic hyperosmolar state may develop and lead to stupor, coma and, in absence of effective treatment, death (2). Often symptoms are not severe, or may be absent, and consequently hyperglycemia sufficient to cause pathological and functional changes may be present for a long time before the diagnosis is made. The long–term effect of diabetes mellitus include progressive development of the specific complications of retinopathy with potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with risk of foot ulcers, amputation, Charcot joints, and features of autonomic dysfunction, including sexual dysfunction. People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease.

Classification of Diabetes Mellitus:

1. The insulin-dependent, ketosis-prone type of diabetes, which is associated with increased or decreased frequency of certain histocompatibility antigens (HLA) on chromosome 6 and with islet cell antibodies,
2. The non-insulin-dependent, non-ketosis-prone types of diabetes, which are not secondary to other diseases or conditions, be considered a second distinct subclass of diabetes [noninsulin-dependent diabetes mellitus (NIDDM)]. This subclass has been divided-according to whether or not obesity is present (obese NIDDM and non-obese NIDDM, respectively), and patients in this subclass can be further characterized by the type of treatment they receive (insulin, oral hypoglycemic agents, diet) or by other characteristics of interest to the researcher
3. The types of diabetes caused by other conditions or found in increased frequency with other conditions (implying an etiologic relationship) be considered a third subclass of diabetes mellitus—diabetes associated with certain conditions and syndromes.
4. Gestational diabetes which is restricted to women in whom glucose intolerance develops or is discovered during pregnancy.
5. Individuals with plasma glucose (*P*G) levels intermediate between those considered normal and those considered diabetic be termed to have impaired glucose tolerance. It is proposed that the terms chemical, latent, borderline, subclinical, and asymptomatic diabetes.(3)

Specific types of diabetes mellitus may be due to hormone disturbances, genetic problems, drug induce or chemicals or pregnancy.(4)

Criteria for diagnosis of DM in non-pregnant adults.

In clinical setting

a. classical symptoms and random blood sugar more than 200gm\dl
b. elevated fasting glucose concentration on more than one occasion more than 140gm\dl for venous plasma sample and 120 for capillary or venous whole blood.
c. fasting glucose concentration less than that which is diagnostic for DM but elevated oral glucose tolerance test. The WHO require the two hour sample meet these criteria
   Venous sample more than 200 gm\dl
   Venous whole blood more than 180 gm\dl
   Capillary sample more than 200gm\dl. (5)

Diabetes mellitus is associated with a series of macrovascular and microvascular changes that can manifest as a wide range of complications. Foot ulcers affect 2-4% of patients with diabetes mellitus (6, 7).

Atherosclerosis:

Peripheral arterial insufficiency which comes usually from atherosclerotic problems leads to decrease blood supply to the tissues and liability to ulceration and infection with poor healing of the ulcers especially in the foot. They either comes from diabetes mellitus or comes concomitantly with it.

Diabetic foot:

People with diabetes are at increased risk of peripheral arterial disease and neuropathy, as well as having a higher risk of developing infections and decreased ability to clear infections. Therefore, people with diabetes are prone to frequent and often severe foot problems and a relatively high risk of infection, gangrene and amputation. Motor, sensory and autonomic fibers may all be affected in people with diabetes mellitus which will lead to formation of painless trauma and Charcot's joint.(8)

Motor fiber abnormalities lead to undue physical stress, the development of further anatomical deformities (arched foot, clawing of toes), and contribute to the development of infection(9).

Many modalities for the treatment of diabetic foot that includes good control of diabetic state, wound care, dressing sometimes and good cover of antibiotics(10). New modalities of therapy are to use carbothera to facilitate the wound healing.

Carbothera:

Which is soda-spa refers to the warm water that dissolves carbon dioxide, another name for it is Soda Bath. On the other hand, artificial soda spa refers to carbon acid hot water with clean carbon dioxide dissolved in it. From the perspective of the properties of carbon dioxide, hot water with high temperature cannot dissolve carbon dioxide with high concentration Currently, this equipment is introduced in various fields such as medical institutions, medical service facilities, hydrotherapy facilities, the Beauty Parlor, fitness club, Hair dressing Parlor and so on, not only limited in medical treatment, but also in Beauty, Fitness fields(11). Carbothera therapy has a great role in the therapy of diabetic foot without surgical interference.

Epidemiology:

The results of cross-sectional community surveys in the UK showed that 5.3% (type 2) and 7.4% (types 1 and 2 combined) of people with diabetes had a history of active or previous foot ulcer(12).Over 700,000 people in the United States have type 1 diabetes; this is 5-10% of all cases of diabetes mellitus. Type 2 diabetes is believed to affect more than 15 million adult Americans, 50% of whom are undiagnosed. However with the increasing incidence of childhood obesity and concurrent insulin resistance, the number of children diagnosed with type 2 diabetes has also increased worldwide.

An annual incidence of 2.2% was found in a large community survey in the UK, and up to 7.2% in patients with neuropathy(13).

Painful diabetic neuropathy is estimated to affect between 16% and 26% of people with diabetes (14).

The incidence of major amputation is between 0.5 and 5.0 per 1,000 people with diabetes(15).

The aim of study :

To discuss if there is any effect of hypertension and atherosclerotic problems as coronary heart diseases and cerebrovascular accident and peripheral insufficiency in the treatment of diabetic foot by carbothera therapy.

Patients and method :

This study was performed in diabetes and endocrine center in Al-Nasiriya during the period from (2008_2015)All the patients have diabetes ,some of them was type one diabetes mellitus and some of them was type 2 diabetes mellitus .Age of patients was ranged from (7 _82)years old. We divide the patients regarding their age into three groups.

Table 1:- Characters of the studied patients

Character	Type	Number of patients	Frequency
age	Less than 15 years 15-45 years More than 45	3 118 679	1% 15% 84%
sex	Male Female	426 374	53% 47%
occupation	Self-employer Housewife retired	244 360 196	31% 45% 24%
address	Urban Rural	526 274	57% 33%
History (duration) of injury	One week Week _month Month _2 months 2months _3 months >3months	27 227 272 126 148	3% 29% 34% 16% 18%
Type of treatment	Insulin Oral hypoglycemic agent Diet	457 330 13	57% 41% 2%
smoking	Smokers Non-smoker	144 656	18% 82%
Concomitant diseases	Only diabetes With another atherosclerotic diseases*	516 284	65% 35%
Session numbers$	<10 11_20 21_30 31_40 >40	189 404 85 44 78	23% 51% 11% 5% 10%

*Another atherosclerotic diseases as HT, cardiovascular diseases and cerebrovascular diseases or peripheral insufficiency.
$Every session continues for about half hour in every alternative day

The patients subjected to close follow up, we give the patient a chance of ten sessions that can be repeated frequently till complete healing. The frequency of sessions was as follows.
Most of our patients used several modalities of therapy to treat diabetic ulcer for several weeks or months without benefit before they use carbothera therapy.

Table:-2 Atherosclerotic problems

	Frequency	Percent
HT	218	77%
Ischemic heart diseases	42	15%
Cerebrovascular diseases	6	2%
Peripheral arterial diseases	18	6%
total	284	100%

Height, weight, and systolic and diastolic blood pressure were measured. Blood pressure was measured with a standardized sphygmomanometer after at least 5 min of rest, according to the Hypertension Detection and Follow-up Program protocol.
After a 12-h fast, blood glucose, total cholesterol, triglyceride, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein-cholesterol (LDL-C) and VLDL, blood urea and serum creatinine levels were measured using the hexokinase method ,AU 5400 Auto analyzer; using minividas instrument (made in Italy). The patients were investigated for Hb and HbA1c. HbA1c was measured with high-performance liquid chromatography (HLC-723 G7; Tosoh Corporation, Tokyo, Japan) according to the standardized Diabetes Control and Complications Trial assay. GUE was done also for every patient.

History of atherosclerosis including history of coronary artery disease, CVA, peripheral arterial insufficiency had been taken in consideration.
We send all the patients for electrocardiography which was the policy for the diabetic center, some of the patients with ischemic heart diseases had a history of cardiac catheterization, Echo cardiogram. Some of our patients send for CT scan on need as part of the diagnosis of cerebrovascular accidents,
Fasting blood samples were obtained for blood sugar (venous blood samples taken after overnight fast of a minimum of 8 hrs.). The kit used for biochemistry was biomerieux (France) while the kit used for blood sugar was randox, s.cholestrol and s.triglyceride was bioLABO, other component of lipid profile had been checked also.

HbA_{1c} was measured by immunoturbidimetric assay with a Cobra Integra 800 automatic analyzer (Roche Diagnostics, Basel, Switzerland) with a reference value of 4.4–6.0%.general urine examination was assessed

Selection criteria:

We chose the patients randomly without specific **selective criteria**

Exclusion criteria:

We exclude patients with:-

1.Patients that use carbothera to treat neuropathy (burning and tingling sensation) :

Because our subject is not about using carbothera for treatment of neuropathy

2. Burn: Because the mechanism of burn is different from that in diabetic foot, and there`s no relation between diabetes mellitus and burn.

3. Fungal infection: athletic foots, because those patients need special antifungal therapy and special care beyond our subject.

Result:

It is well known the significance of smoking in all kinds of atherosclerotic problems and hypertension therefore; we find it important to mention it with our study.

1. Relationship between session's numbers and smoking.

Both group, smoker or non-smoker get benefit from carbothera therapy as we can see most of the patients improve below 20 sessions and very significant statistical relationship between number of sessions and smoking status was found, which is clear that decrement in number of patients in second row from 330 to 65 then 32, while in smoker there is decrement inpatients number from 74 to 23 indicate the greatest benefit of carbothera therapy for the non-smoker versus smoker one (p=0.002) about one quarter (25%) of the non- smoker patients get benefit in less than 10 sessions in compare with 20 (14%) patients from the smoker.

Table3:-Session numbers * smoking (chi-square = 12.7,p value =0.002)

Session number	Smoker	Non smoker	Total
Less than 10	20(14%)	169(25%)	189
11-20	74(51%)	330(50%)	404
21-30	20(14%)	65(10%)	85
31-40	12(8%)	32(5%)	44
More than 40	18(13%)	60(10%)	78
total	144(100%)	656(100%)	800

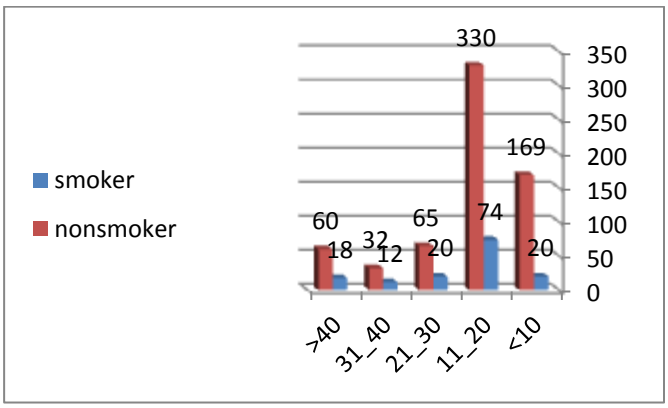

Figure1:- effect of smoking on the sessions number of carbothera therapy.

We found that there`s significant association between sessions number and smoking.

2. Relationship between session's number and other concomitant atherosclerotic diseases.

We divided the patients into two groups, those with diabetes mellitus alone and those with diabetes and other concomitant atherosclerotic diseases as hypertension, cerebrovascular accidents, ischemic heart diseases and peripheral insufficiency.

No clear association was found and the patients number decrease in both groups, most of the patients(74% and 75% respectively) whether DM alone or with other atherosclerotic diseases get the greatest benefit below 20 sessions and they are nearly the same in all groups of sessions that mean the number of patients in all groups of sessions change in the same manner with nearly negligible changes that mean the presence of other atherosclerotic problem does not the beneficial effect of carbothera therapy.(p value=0.88).

Table 4:- Session numbers *concomitant diseases (chi-square =1.4, p value =0.88).

Session number	Diabetes mellitus alone	DM with concomitant dis Atherosclerosis)(	Total
Less than 10	122 (24%)	67(24%)	189
11-20	259(50%)	145 (51%)	404
21-30	54(10%)	31 (11%)	85
31-40	32(6%)	12(4%)	44
More than 40	49(10%)	29(10%)	78
total	516(100%)	284(100%)	800

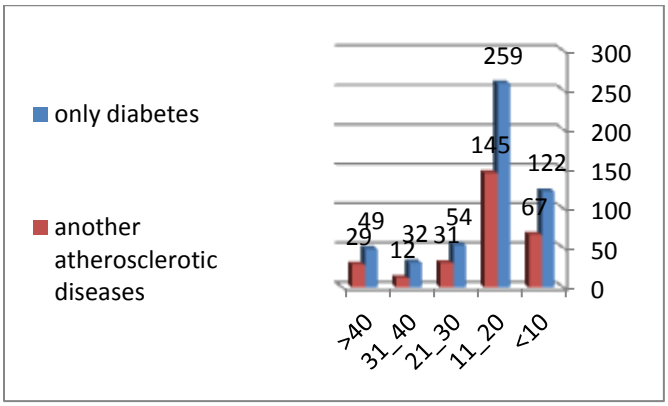

Figure2:- Effect of hypertension and atherosclerotic problems on carbothera therapy

Limitations of the study:

Carbothera is a new modality of therapy, and very few studies in the world about this subject. We find just one descriptive study in AlKufa College of medicine.

Discussion:

In our study we took 800 patients, all of them are diabetic whether type one or type two. It is well known the significant effect of diabetes mellitus whether microvascular or macrovascular complications and DM is the main cause for all the atherosclerotic complications and some time the patients may presents with the complications before diagnosis of DM. in this study we discuss the effect of the presence of smoking status and other atherosclerotic problems on carbothera therapy in diabetic foot.

Carbothera is a new modality of therapy and very few knowledge about it and the effect of smoking, HT and other atherosclerotic problems on its action.

Carbothera in which highly purified water bath with CO2 dissolved in it in certain temperature leads to formation of weak acidic medium and local vasodilatation of the lower limbs blood vessels, the factor that leads to enhancement of healing and rapid growth of the injured tissue. A probable direct effect of the acidic medium on the bacterial infection or the pro inflammatory substances in the injured limb may take place.

Smoking is well known the main cause of HT, ischemic heart diseases and cerebro vascular accidents or peripheral effect and the presence of smoking with DM enhance atherosclerosis and ischemic limbs the process that leads to poor blood supply to the peripheral tissues and liability to infection and poor blood supply.

In our study we find one quarter of the non-smoker patients get benefit and their leg ulcers heals in less than 10 sessions in compare with 14% of the smoker patients their leg ulcers healing less than 10 sessions. Some studies discuss the effect of smoking with atherosclerosis or with DM but no one mention the effect of smoking on carbothera.

The main stems for diabetic foot ulcers are:

1. Atherosclerotic arteries with poor blood supply to the ischemic limb.
2.Peripheral neuropathy with recurrent trauma without sensation.
3. Bad control blood sugar which is a good media for bacterial growth.
4. Bad hygiene to the injured limb.

The patients that attend the sessions of carbothera all of them have DM but some of them are children or newly diagnosed IDDM or NIDDM before the occurrence of atherosclerotic complications but with diabetic ulcer and on the other hand some of the patients with advance atherosclerotic due to DM itself or due to the concomitant disease as HT, IHD, CVA or peripheral insufficiency, so the effect of carbothera lies on the capillaries or very small arteries that dilate with the effect of carbothera irrespective to the presence or absence of atherosclerotic problems. The other explanation is that diabetes itself is a tragedy by itself, cause more co morbidity ,more atherosclerotic changes also may become the leading cause for hypertension and cerebro vascular accident and ischemic heart disease, therefore; the presence or absence of other concomitant diseases cause minimal changes on sessions of carbothera therapy as a result we didn't find any association between sessions number and presence or absence of concomitant atherosclerotic problems with DM, the p value was 0.88 (table 4). There are no previous studies that discuss the relationship between sessions number of carbothera and concomitant diseases. We find only one study in AlKufa which was just descriptive one (11).

Conclusion:

1. Carbothera is very important non-surgical treatment of diabetic foot. it`s a new modality with a great benefit for the patient.
2.If the patient exceed 40 sessions the benefit from the sessions will be less although preserved.
3. Good relationship between session's number and smoking status. Smoker patients get less benefit than non-smoker one regarding carbothera therapy
4. Early therapy makes better results.
5. Presence of other concomitant atherosclerotic diseases like HT, IHD, CVA or peripheral insufficiency doesn't affect sessions of carbothera therapy.

Recommendation:

1. Every patient with diabetic foot should have their chance for carbothera therapy.
2. Smoking must be stopped because they will get less benefit from carbothera than the others.

3. Good control DM is the most important protective manner before any modality of therapy.
4. Early therapy and early visits to the doctor make fewer traumas, less cost effectiveness and less stress to the patient and to the medical staff.

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