

Management And Outcome Of Diabetic Charcot's Foot: Jabir Abueliz Diabetic Center Experience 2019 (JADC)

Shazali Mohamed Ahmed Mohamed¹ , Abu Bakr Hassan Widatalla ²

1-Registrar of general surgery

2-Consultant of general surgery, Ibrahim Malik Teaching Hospital

Corresponding Author: Email: d_smam@hotmail.com

Abstract:

Charcot foot is a rare but a serious diabetic related condition. Usually it is misdiagnosed although its prognosis related to timely and proper management

Objective: To study the management and outcome of diabetic Charcot's foot in Jabir AbuEliz diabetic center in period between 2012 and 2019

Methods: A combined retro-prospective descriptive analytical study and hospital based. Study conducted to 134 diabetic patients with charcot joint attended to JADC during the study period. The study sample was calculated by total coverage. Study questionnaires captured mainly quantitative data. Data analyzed by using SPSS version 21.

Results: 134 diabetic patients with charcot joint were involved in this study, most of the patients were males, in the age group 51-60 years and had NIDDM associated with other medical disorders. At the time of presentation, 91% of the patients presented with swelling and 53.7% of the patients had pain. On examination of the foot; 84.3% of the patients had swelling and 59.7% of the patients had dry skin. Hammer toes deformity was the commonest feet deformity. Based on modified Sella and Barrette classification, 17.2% of the patients in grade 1. Casting was performed to all patients with good outcome to 91.1% of the patients

Conclusion: This study reveals that grade 0,1&2 Charcot neuroarthropathy feet had good outcome if properly recognized and early managed. The total contact cast (TCC) and CAM walker is effective in the management.

Introduction:

Charcot arthropathy or Charcot joint is a progressive condition of musculoskeletal system that is characterized by joint dislocation, pathological fracture and debilitating deformity. Syphilis was believed to be the most common cause of Charcot arthropathy until 1936, when Jordan linked it to diabetes (the most common cause of Charcot joint now).^(1,2)

Charcot arthropathy results in progressive destruction of bone and soft tissue at weightbearing joint. It can occur at any joint but most commonly in the lower extremity. The incidence of Charcot arthropathy is 0.1 to 5% in diabetic neuropathy. The prevalence of Charcot neuroarthropathy ranges from 0.08 to 8.5%.^(3,4) Charcot arthropathy is more common unilaterally, it can involve both lower limbs in 39%.⁽⁵⁾

Pathophysiology of Charcot joint is unknown till now but there are two major theories: neurotraumatic and neurovascular.⁽⁶⁾

The clinical presentation and symptoms of Charcot arthropathy can range from mild swelling, mild deformity to severe deformity and significant swelling. Pain is the presenting symptom in some cases. Instability and loss of joint function also may be present. The incidence of ulceration is 17% per year.⁽⁷⁾

On examination the signs of inflammation are present. Unilateral swelling with an increase in local skin temperature, erythema, joint effusion and bone resorption in an insensate foot are present. Usually the skin is intact the protective sensation is lost. The increase in local skin temperature in affected sites increased by (> 2degree) above unaffected foot's skin temperature.

Sella and Barrette develop a five stage classification scheme based on radiographs, clinical findings and bone scan.⁽⁸⁾

Laboratory studies included complete haemogram & ESR, CRP, renal function with electrolyte, blood glucose level, HA1C and serum calcium. Imaging studies include plain radiograph and in some cases MRI.⁽⁹⁾

In medical treatment once the process is recognized it should be treated via the VIPs (vascular management, infection management, prevention and pressure relief).⁽¹⁰⁾ The aim of treatment is Pressure relief or off loading and immobilization with total contact cast (TCC) which helps prevent joint destruction. In some situations uses of control ankle motion walker is of value. Many surgical procedures and techniques were used in treatment of Charcot joint depending on

location of the disease and surgeon's experience with the condition. For example: osteotomy, arthrodesis, screw & plate fixation, open reduction and internal fixation, reconstructive surgery and amputation.

Methods :

A cohort prospective study was conducted between April 2012 and June 2019 in Jabir AbuEliz Diabetic Center (JADC), Khartoum, Sudan. It included 134 diabetic patients with Charcot arthropathy (study group). All patients had an informed consent, and the study was approved by the ethical committee in JADC.

All patients who presented to our outpatient clinic with diabetic Charcot arthropathy underwent clinical, laboratory and imaging studies. The data were collected using a predesigned form and included the history, physical examination, investigations and management. The patients were followed up regularly in the foot clinic.

Clinical assessment included the signs of inflammation, swelling with an increase in local skin temperature, erythema, joint effusion and bone resorption in an insensate foot . The increase in local skin temperature in affected sites increase (more than 2 degree) above unaffected foot's skin temperature using hand held infrared thermometry. Vibrating tuning fork and 10g Semmes Weinstein monofilament and position sense were used to evaluate presence of neuropathy. Probe-to-bone test was performed using a sterile probe to palpate the suspicious osteomyelitic bone at the base of ulcer or sinus if present. Vascular assessment through clinical examination, hand held doppler and ankle brachial pressure index. Duplex ultrasound and ankle brachial index were also used.

Laboratory studies included complete haemogram with ESR, CRP, renal function with electrolyte, blood glucose level, HA1C and serum calcium.

Imaging studies included plain radiographs to help stage disease, to determine stability of joint, subluxations, osteopenia, destruction and fractures. Magnetic Resonance imaging (MRI) was used selectively when there was no correlation between clinical pictures and plain radiograph. The classification of Charcot arthropathy based on modified Sella and Barrette staging. Sella and Barrette developed a five stages classification scheme based on radiographs, clinical findings and bone scan. We modified the classification by adding fractures and osteomyelitis :

Stage 0 : consist of localized heat and swelling of medial column, radiographs are normal

Stage 1 : early bone involvement is seen in radiographs (localized osteopenia, subchondral cyst & erosion)

Stage 2 : consist of joint subluxation

Stage 3 : consist of dislocation & joint collapse

Stage 4 : presence of fractures

Stage 5 : presence of osteomyelitis

Stage 6 : represents healing & radiographic findings include sclerosis and fusion of affected bone or joint

Another common used classification system is the Brodsky and Rouse system. It describes three anatomical Charcot :

- Type 1 involves the midfoot
- Type 2 involves the hind foot
- Type 3 involves the ankle

The foot can be divided into the hindfoot, midfoot and forefoot. Hindfoot composed of the talus and calcaneus. Midfoot composed of the cuboid, navicular and 3 cuneiform. Forefoot composed of the 5 toes and 5 metatarsal bones. Tibia and fibula connected to talus bone to form the ankle joint.

The treatment consist of Total Contact Cast of affected limb. Cast was checked every 2 weeks to evaluate for proper fit and changed if mandate. Serial plain radiographs were taken approximately every 2-4 weeks. Casting usually discontinued on the basis of clinical, radiological and dermal thermometric signs of quiescence. If the difference between Charcot limb and normal limb is less than 2 degrees based on hand held thermometer, the cast is replaced by controlled ankle motion(CAM) walking boot. The idea was to mobilize the patients in quiescence Charcot to minimize disuse atrophy that occurred with prolonged contact cast.

The data were analyzed using the SPSS program version 20. Statistical tests using student's t-test for numerical values and Chi square (χ^2) tests were utilized. A P value was considered significant when it was < 0.05 .

Result:

A total of 134 diabetic patients with Charcot arthropathy were included. Males 88 (65.7%) were affected more than females 46 (34.3%) of the patients. The majority of the patients had NIDDM 118 (88.1%). The duration of diabetes ranged between 11-15 years. The patients who depended on oral hypoglycemic control account for 44 (32.8%) and 89 (66.4%) depended on insulin. The majority had no renal complication but eye complication in the form of cataract 20 (14.9%), retinopathy 27 (20.1%) and blindness 4 (3%) Table (1). The chief complains at time of presentation in all cases was swelling in 122 of patients(91%), pain in 72 (53.7%) and fever just in 19 (14.2%). The cause was unknown in about 109 (81.3%) of the patients. Tight shoes, thermal injuries and sharp injuries accounted for small percent Table (2).

On examination just (4%) of the patients were febrile, swelling presented in 113 (84.3%) of the patients, 80 (59.7%) had dry skin, callus was obvious just in 25 (18.7%) and about 97% of all patients had Charcot joint deformity. Small number of the patients had hammer toes 17 (12.7%), pes cavus 2 (1.5%), pes planus 9 (6.7%) and crowded toes in 15 (11.2%).

Depending on the hand held thermometry the difference between Charcot joint and normal limb was more than 2 degrees in 106 (79.1%) of the patient.

The vascular assessment of all patients were normal. The vibration sense was impaired in about 55(41 %) in both limbs, absent in 31(23.1%) and intact in 48(35.8%) of the patients Table (3).

The sensation examination using 10 g monofilament was intact in 44 (32.8%), impaired in 57 (42.5%) and absent in 32 (23.8%) bilaterally.

The position sense was intact in 88 (65.6%), impaired in 36 (26.8%) and absent in 10 (7.4%) in both limb

The classification of Charcot joint in this study depended on modified Sella and Barrette classification. The large percent in grade 1, 23 (17.1%) of the patients and grade 3&4, about 20 (14.9%) of the patients. According to the anatomical classification, the hind foot including ankle joint was involved in 59 (44.02%), mid foot was involved in 42 (31.3%) and fore foot was involved in 33 (24.6) Table (5)

At the time of presentation about 18 (13.4%) of the patients had osteomyelitis and 21 (15.7%) presented with fracture.

All patients underwent casting. The time duration of casting ranged between 3-6 months. The outcome was 122 (91.04%) of the patients healed without complication, 4 (2.98%) developed minor amputation, 1 (0.74%) developed major amputation, 3 (2.23%) developed deformity in form of loss of the medial arch, 3 (2.23%) died and 1 (0.74%) developed ulcer Table (6).

Table (1):Demographic characteristics of 134 patients with Charcot joint

Characteristic	Number of patients
Age	Mean 53.1, median 54, std.Deviation 10.08
Gender	
Male	88 (65.7%)
Female	46 (34.3%)
Type of DM	
IDDM	16 (11.9%)
NIDDM	118 (88%)
Duration of DM(more common)	
11-15 years	23.1% of patient
16-20 years	23.1% of patient
Basic control	
Oral hypoglycemia	44 (32.8%)
Insulin	89 (66.4%)
Not controlled	1 (0.7%)
Systemic hyper tension	24 (17.9%)
Cardiac disease	
Ischemic heart disease	9 (6.7%)
No cardiac problems	110 (82.1%)
Others	15 (11.2%)
Renal disease	
No renal impairment	132 (98.5%)
Raised serum creatinine	2 (1.5%)
Eye disease	
Cataract	20 (14.9%)
Retinopathy	27 (20.1%)
Blind	4 (3%)
No	83 (61.9%)

Table (2):Symptoms, signs and deformities of 134 diabetic patients at the time of presentation:

Symptoms:	Number of patients
Pain	72 (53.7%)
Fever	19 (14.2%)
Malaise	8 (6%)
Swelling	122 (91%)
Discharge	2 (1.5%)
Discoloration	4(3%)
Signs:	
Febrile	4 (3%)
Toxic	2 (1.5%)
Pale	8 (6%)
Confusion	2 (1.5%)
Dehydration	1 (0.7%)
Dry skin	80 (59.7%)
Fissures	37 (27.6%)
Callus	25 (18.7%)
Swelling	113 (84.3%)
Necrosis	1 (0.7%)
Puss	2 (1.5%)
Gangrene	0
Prominent vein	0
Deformities	
Claw foot deformity	7 (5.2%)
Pes planus deformity	9 (6.7%)
Pes cavus deformity	2 (1.5%)
Crowded toes deformity	15 (11.2%)
Hallux deformity	15 (11.2%)
Hammer toes deformity	17 (12.7%)
Prominent metatarsal bones	5 (3.7%)

Table (3):Vascular and neurological assessment of 134 diabetic patients with Charcot joint:

Method	Number of patients
Perfusion in left limb	
Grade 1	84 (62.68%)
Grade 2	43 (32.1%)
Grade 3	7 (5.2%)
Perfusion in right limb	
Grade 1	85 (63.4 %)
Grade 2	42 (31.3%)
Grade 3	7 (5.2%)
Doppler in left limb	
>1.2	12 (8.9%)
>0.9—1.2	110 (82.08%)
0.5—0.9	11 (8.2%)
<0.5	1 (0.74%)
Doppler in right limb	
>1.2	13 (9.7%)
>0.9—1.2	109 (8.1%)
0.5—0.9	12 (8.9%)
<0.5	0
Vibration sense in left limb	
Intact	48 (35.8%)
Impaired	55(41%)
Absent	31 (23.1%)
Vibration sense in right limb	
Intact	49 (36.5%)
Impaired	54 (40.2%)
Absent	31 (23.1%)
10 g monofilament in the right limb	
Intact	
Impaired	44(32.8%)
Absent	57(42.5%)
10 g monofilament in left limb	33 (24.6%)
Intact	
Impaired	44 (32.2%)
Absent	57 (42.5%)
	33 (24.6%)
Position sense in left limb	
Intact	88 (65.6%)
Impaired	36 (26.8%)
absent	10 (7.4%)
Position sense in right limb	
Intact	88 (65.6%)
Impaired	36 (26.8%)
absent	10(7.4%)

Table (4):Extent of neuropathy in 134 diabetic patients with Charcot joint after assessment:

Extent of neuropathy	Number of patient
In left limb	
Fore foot	25 (18.6%)
Mid foot	25 (81.6%)
Heel	12 (8.9%)
Ankle	24 (17.9%)
Distal leg	19 (14.1%)
Mid leg	9 (6.7%)
Other	20 (14.9%)
In right limb	
Fore foot	28 (20.8%)
Mid foot	22 (16.4%)
Heel	11 (8.2%)
Ankle	25 (18.6%)
Distal leg	19(14.1%)
Mid leg	8 (5.9%)
Other	21(15.6%)

Table (5):Modified Sella and Barrette classification in 134 diabetic patient with Charcot joint :

Grades	Number of patient
0 (localized heat and swelling, normal radiology)	18 (13.4%)
1 (localized osteopenia, subchondral cyst and erosion)	23 (17.1%)
2 (joint subluxation)	18 (13.4%)
3 (dislocation and joint collapse)	20 (14.9%)
4 (fractures)	21(15.6%)
5 (osteomyelitis)	18 (13.4%)
6 (quiescence)	16(11.9%)

Table (6): Outcome of 134 diabetic patients with Charcot joint underwent casting:

Outcome	Number of patients
Healing without complication	122 (91.04%)
Healing with minor amputation	4 (2.98%)
Healing with major amputation	1 (0.74%)
Healing with deformities (loss of medial arch)	3 (2.23%)
Develop ulcer	1 (0.74%)
Died	3 (2.23%)

Table (7): The most affected anatomical site in the foot of 134 diabetic patients with Charcot joint:

Anatomical site	Number of patients
Fore foot	33 (24.6%)
Mid foot	42 (31.34%)
Hind foot including ankle joint	59 (44.02%)

Discussion:

Diabetic foot arthropathy or Charcot joint in diabetes account for substantial morbidity, economic cost and time consuming in treatment. It is disabling and devastating condition.

In our study we found that male was affected more than female by ratio of about 2:1 (88:46), the mean age was 53 years, the majority of patients had NIDDM 118 (88%), the mean duration of diabetes was 15 years (– or + 5 years). In comparison to a study done in Ireland which showed the majority of patients were male (68%), the mean age was 58 years, most patients had type 2 diabetes mellitus and the main duration of diabetes was 15 years (-or+9 years).⁽¹¹⁾ In our study 81.3% of patients did not recall any precipitating factors for Charcot joint in comparison to other a study which showed 73% of patients.⁽¹²⁾

The diagnosis was established after good history and clinical examination and radiological imaging. The main presenting symptom was swelling in 91% in comparison to a study that said the main reason for medical consultation in diabetic Charcot joint was persistent swelling.⁽¹³⁾ Some time the condition

associated with pain and fever in acute state.

On examination the swelling accounted for 84.3% of symptoms and signs in comparison to a study which showed fever, swollen and tenderness were the main symptoms that made the differential diagnosis of acute gout, cellulites and deep vein thrombosis were there in acute presentation.⁽¹⁴⁾ The common observed presentation deformities in our study were hammer toes in (12.7%), hallux deformity in (11.2%) and pes planus deformity in (6.7%) in comparison to a study showed that the common observed deformity was a rocker-bottom deformity of the foot.⁽¹⁵⁾

The presence of neuropathy was determined by clinical examination using 10g monofilament which is impaired in (42.5%) of the patients, 128 Hz tuning fork examination which was impaired in a bout (41%) and position sense impaired in about (26.8%) of the patient in comparison of a study showed 100% of patients had documented peripheral neuropathy. 7% of our patients had peripheral vascular disease in comparison to same last study which showed 2% of patient had peripheral vascular disease.⁽¹¹⁾

The gold standard to determine medical treatment in form of total contact cast (TCC) depended on hand held infrared thermometer. In our study the 79.1% of patient had difference of more than 2 C degree between Charcot joint and normal joint. In comparison to other studies which showed that there was often a temperature difference between two feet of several degree.^(12,16)

The casting was continued until swelling resolved and temperature of affected foot was less than 2 degrees C of the contra lateral foot as showed in a study used same method.⁽¹⁷⁾

The outcome after TCC was 91.04% of the patients healed without complication, 2.98% developed minor amputation, 0.74% developed major amputation and 0.74% developed ulcer due to cast. In comparison to a study showed 32% of patients healed without complication, 40% developed ulcer and 17 % required lower limb amputation in patient who received offloading treatment.⁽¹¹⁾

The time of healing of acute Charcot (quiescence phase) with TCC in the study was 3-6 months. In comparison to Armstrong study which revealed that the healing rate of Charcot joint in diabetic patients using TCC was 130 days(-or+74 days).⁽¹²⁾ In other study the average time of healing was 86 days(-or+45 days).⁽¹⁸⁾

Immobilization and offloading of diabetic Charcot joint remain the mainstays of therapy, other options are being tested for example Bisphosphonates which are

potent inhibitors of bone resorption. ⁽¹⁹⁾ However a few case reports have examined this treatment as an alternative.

In our study the aim was to mobilize the patients early after acute Charcot's joint by supervised Controlled Ankle Motion (CAM) walker.

Conclusion:

The use of Total contact cast and CAM walker reloading in the management of diabetic Charcot Joint enhances the healing and early quiescence

References:

1. Kelly M. William Musgrave's De Arthritide symptomatic (1703): His description of neuropathic arthritis. *Bull Hist Med.* 1963. 37:372-6
2. Charcot JM. Sur quelques arthropathies qui paraissent dependre d'une lesion du cerveau ou de la moelle epiniere. *Arch Des physiol Norm et path.* 1868. 1:161-71
3. Brodsky JW, Rouse AM. Exostectomy for symptomatic bony prominences in 407 diabetic charcot feet. *Clin Orthop Relat Res* 1993;21-26.408 6.
4. Armstrong DG, Peters EJ. Charcot's arthropathy of the foot. *J Am Podiatr Med Assoc* 2002;92:390-394.
5. Larsen K, Fabrin J, Holstein PE. Incidence and management of ulcers in diabetic 417 Charcot feet. *J Wound Care* 2001;10:323-328
6. LaFontaine J, Lavery L, Jude E. Current Concepts of Charcot Foot in Diabetic Patients, *The Foot* (2015), <http://dx.doi.org/10.1016/j.foot.2015.11.001>
7. Larsen K, Fabrin J, Holstein PE. Incidence and management of ulcers in diabetic 417 Charcot feet. *J Wound Care* 2001;10:323-328
8. Sella EJ, et al. Staging of charcot neuropathy along the medial column of the foot in the diabetic patient. *J Foot Ankle Surg.* 1999 Jan-Feb
9. Schlossbauer T, Mioc T, Sommerey S, Kessler SB, Reiser MF, Pfeifer KJ. Magnetic resonance imaging early stage Charcot arthropathy: correlation of imaging finding and clinical symptoms. *Eur J Med Res.* 2008 sep22. 13(9):409-14
10. Snyder, R.J., et al., The management of diabetic foot ulcers through optimal off-loading building consensus guidelines and practical recommendations to improve outcomes. *J Am Podiatr Med Assoc*, 2014. 104(6): p. 555-67
11. O'Loughlin, A., Kellegher, E., McCusker, C. et al. *Ir J Med Sci* (2007) 186: 151. Doi:10.1007/s11845-016-1508-5
12. Armstrong DG, Todd WF, Lavery LA, Harkless LB, Bushman TR (1997) The natural history of acute Charcot's arthropathy in a diabetic foot speciality clinic. *Diabet Med* 14:357-363
13. Wilson M (1991) Charcot foot osteoarthropathy in diabetes mellitus. *Mild Med* 156:563-569

14. Sinha SB, Munichoodappa CS, Kozak GP (1972) Neuroarthropathy (Charcot joints) in diabetes mellitus. Clinical study of 101 cases. *Medicine (Baltimore)* 51:191-210
15. Sella EJ, Barrette C (1991) Staging of Charcot neuroarthropathy along the medial column of foot in diabetic patient. *J Foot Ankle Surg* 38:34-40
16. McGill M, Molyneaux L, Bolton T, Ioannou K, Uren R, Yue DK. Response of Charcot's arthropathy to contact casting: assessment by quantitative techniques. *Diabetologia* 2000;43:481-484
17. Armstrong DG, Lavery LA. Monitoring healing of acute Charcot's arthropathy with infrared dermal thermometry. *J Rehabil Res Dev* 1997;34:317-321
18. Sinacore DR. J Diabetes complication. Acute Charcot arthropathy in patients with diabetes mellitus: healing times by foot location. Sep-Oct 1998
19. Selby PL, Young MJ, Boulton AJ. Bisphosphonates: a new treatment for diabetic Charcot neuroarthropathy?. *Diabet Med.* 1994 Jan-Feb. 11(1):28-31