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Case Report

The charcot joint osteoarthropathy: a case report

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ABSTRACT

The Charcot Joint Osteoarthropathy also referred as Charcot foot syndrome is a serious lower limb-threatening complication of diabetes. A patient was diagnosed with Charcot joint osteoarthropathy (COA) and found to have uncontrolled Diabetes Mellitus since more than 10 years. This case is crucial considering that Diabetes mellitus is a common case that we encounter, but the consequences of not being controlled can lead to serious complications. Accurate diagnosis is not always easy and can be a considerable clinical challenge. It needs to be differentiated from other conditions that has similar symptoms. Early diagnosis and initiation of treatment is crucial to avoid devastating and permanent complications.

Keywords: Charcot osteoarthropathy, Diabetes mellitus

INTRODUCTION

Charcot joint osteoarthropathy (COA) or commonly known as Charcot foot is a progressive condition of the musculoskeletal system that is characterized by joint dislocations, pathologic fractures, and debilitating deformities that mainly affects diabetic patients with neuropathy. It is named after Jean-Martin Charcot, who first described it in 1868.[2] Diagnosis is based on clinical manifestation and imaging studies. There is a lack of awareness of its prevalence and could misdiagnosed with other disease.

Acute COA needs to be differentiated from other conditions that cause pain and swelling, notably cellulitis, trauma or sprain, acute gout, deep vein thrombosis and osteomyelitis.[17] A basic examination is an X-ray of the talus and the weight bearing foot in the anteroposterior and dorsoplantar lateral projection.[4] It is important to exclude infection, i.e., cellulitis or osteomyelitis.

CASE REPORT

A 51-year-old female came to ER with wound on her right foot. She also complains of worsening fatigue and nausea over the past 48 hours and She did not experience any pain on her right toes. The patient has been hospitalized in the past for non-healing wounds on her right foot; and wound care measures have been carried out 1 month before the current ER visit. Her past medical history was uncontrolled Diabetes Mellitus since more than 10 years, the patient received rapid acting insulin treatment (6 IU, 3 times at meal time by subcutaneous injection) and long-acting insulin treatment (4 IU at bed time by subcutaneous injection) But she admitted sometimes she forgot to inject it at intervals of 1 to 2 days in a month.

On physical examination, vital signs were normal, Right distal extremity findings rocker bottom deformity and deep ulcer with localized gangrene in calcaneal region (Figure 1). No edema or pain was found.

Routine laboratory findings: Haemoglobin 8, 2 g/dL, White Blood Cells 25.820 /µL, Haematocrit 25.2%, Thrombocyte count 509.000 /µL, AST 3 U/L, ALT 10 U/L, BUN 30 mg/dL, Serum Creatinine 1,1 mg/dL, Natrium 131 mmol/L, Potassium 4,4 mmol/L, Chloride 8,1 mmol/L Serum Albumin 2,2 g/dL, peripheral blood smear showed Anemia due to chronic disease.

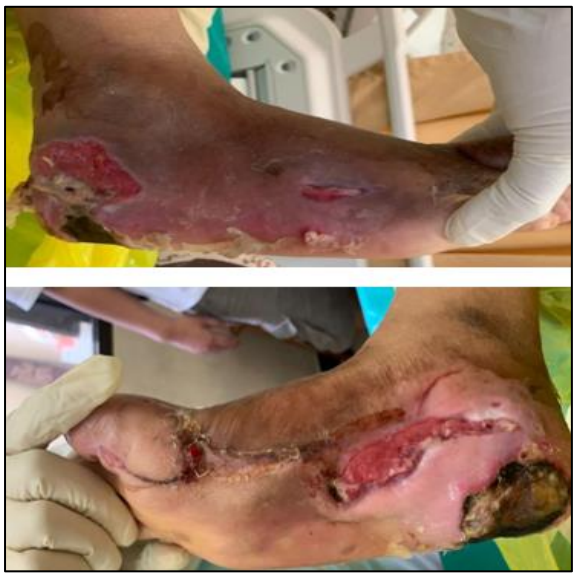

Figure 1: Right foot, rocker-bottom deformity with deep ulcer and localized gangrenous in calcaneal region.

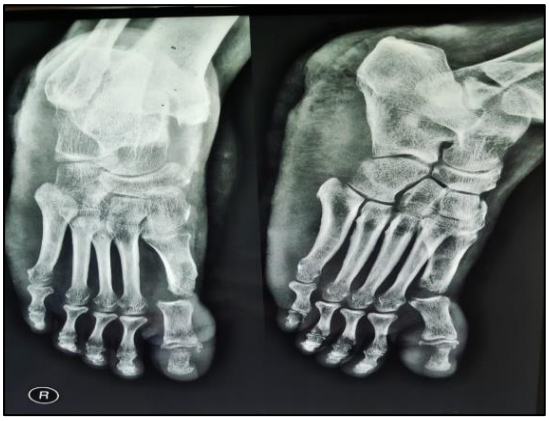

Figure 2: Right foot radiography AP/Oblique projection.

AP and Oblique right foot X-Ray projection was destruction of caput metatarsal I, soft tissue swelling with scalloping cortex phalanx distal I, gas gangrene soft tissue pedis dextra (Figure 2). All the evidence leading to Osteomyelitis radiographic appearance and charcot joint deformity of the right foot.

We established the diagnosis for this patient were Type 2 Diabetes Mellitus, charcot foot of the right ankle, anemia due to chronic disease, and hypoalbuminemia.

In this case we are working with the surgical department and surgical debridement was planned.

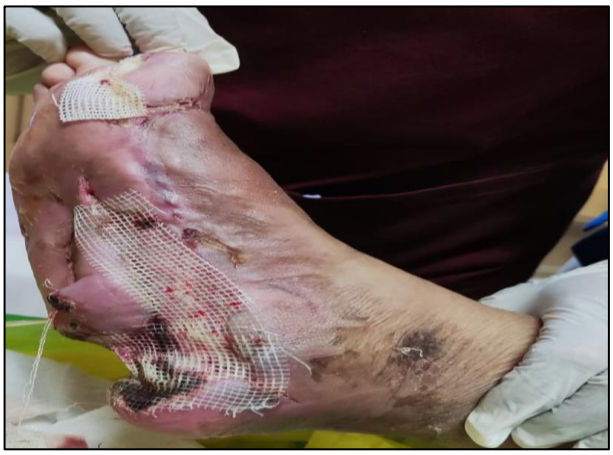

Figure 3: Right foot after surgical debridement.

Intravenous Cefotaxime 1-gram every 12 hours was given since day one, and intervenous Levofloxacin 500 mg every 24 hours, intervenous Metronidazole 500 mg every 8 hours after surgical debridement was done. Patient also received 2 Packed Red Cells due to anemia, 4 Units of subcutaneous rapid acting insulin 3 times at meal time with 4 units subcutaneous long-acting insulin at bed time were given in the 2nd day after surgical debridement for Blood sugar regulation, for correction of hypoalbuminemia, a total of 2 flasks of 20% human albumin were given after surgical debridement, increasing the serum albumin level to 2,2 - 2,5 g/dL throughout treatment duration. Patient underwent surgical debridement successfully with no serious complications (Figure 3) and discharged with scheduled follow-up appointment at outward clinic.

DISCUSSION

Pathophysiology

The neurovascular and neurotraumatic theories have classically been proposed to explain the pathogenesis of COA. However, recent evidence suggests that a combination of the two theories is likely to provide the most accurate explanation for disease pathogenesis.[1,2]

Neurovascular theory (French theory)

The neurovascular theory is based on the presence of vasomotor neuropathy in individuals with sensory neuropathy and intact blood flow. Increased blood supply to bone as the principal etiological factor. Increased blood flow could lead to bone resorption and mechanical weakening, ultimately resulting in fractures and deformity. At the same time, increased blood flow becomes clinically manifest as a warm foot with dilated veins. Increased venous pressure associated with autonomic neuropathy also may increase capillary pressure and promote leg edema.[2,5,18]

Neurotraumatic theory (German theory)

The neurotraumatic theory considers the Charcot joint an exaggerated overuse injury. Volkman and Virchow suggested that peripheral neuropathy leading to loss of protective sensation may render the foot susceptible to injury. Either repetitive microtrauma or an acute episode of trauma may initiate the process in individuals who do not have normal protective sensation. Pathology worsens with continued weightbearing (hence the term neurotraumatic). Thus, fractures might ensue and, in the case of continued activity, patients could end up with severe deformities.[2,5,18]

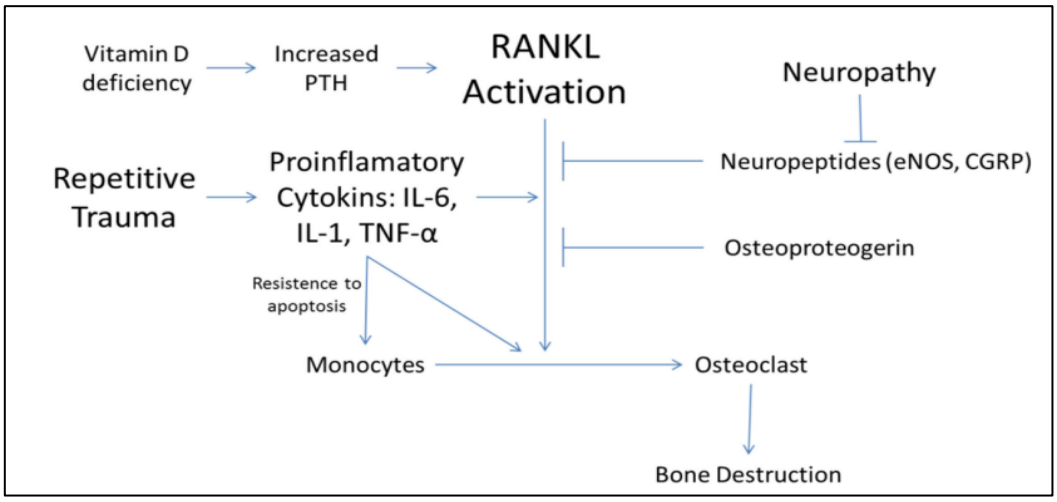

Figure 4: RANKL pathway in the pathophysiology of Charcot arthropathy.[3]

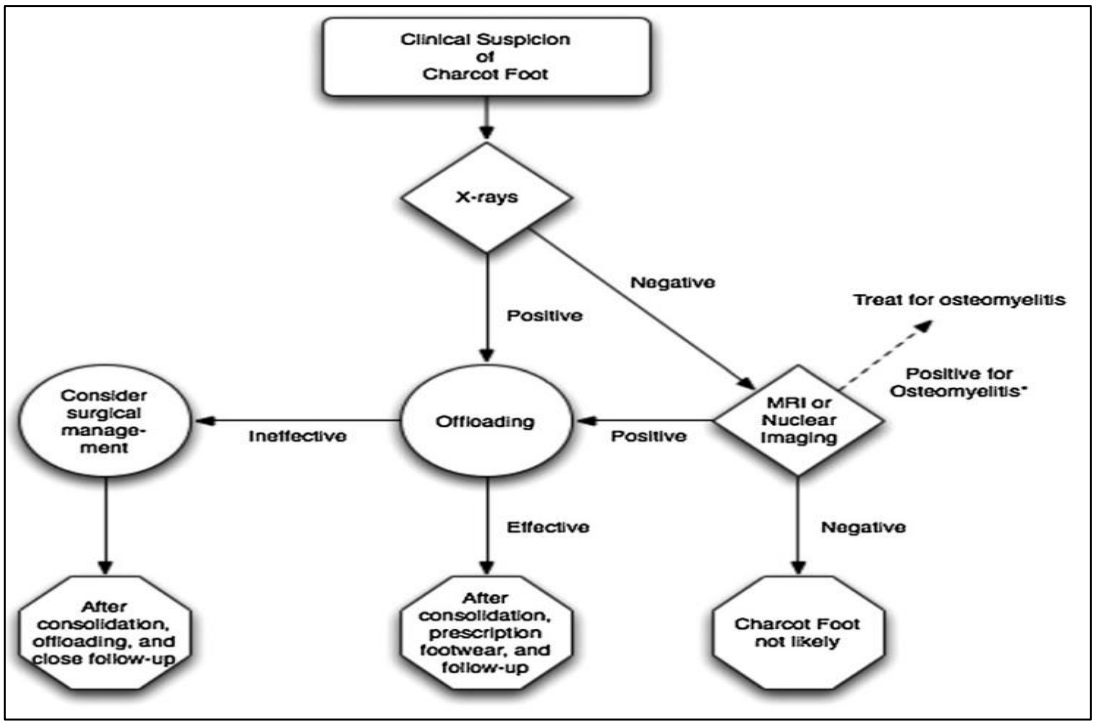

Figure 5: An algorithm depicting the basic approach to the charcot foot.[4]

Additional potentially contributory factors

There are many additional potentially contributory factors that cause the occurrence of COA such as bone pathology, atypical neuropathy, non-enzymatic collagen glycation, increased plantar pressures and excessive local inflammation.[2,6-9] But most important factor is excessive local inflammation. The local inflammation is indispensable factor that triggers the course of events on a predisposing environment. Increased amounts of

proinflammatory cytokines, especially TNFa is found to be responsible for triggering another cytokine pathway that is centred on the poly-peptide, the receptor activator of nuclear factor-kB (NF-kB) ligand (RANKL).

Table 1: The modified Eichenholtz classification, Stages I-III described by Eichenholtz, Stage 0 added by Shibata et al because clinical signs of Charcot arthropathy were found to precede radiographic changes.[13]

Stage	Radiographic findings	Clinical findings	Treatment
0 (Prodromal)	Normal radiographs	Swelling, erythema, warmth	Patient education, serial radiographs to monitor progression, protected weightbearing
I (Development)	Osteopenia, fragmentation, joint subluxation or dislocation	Swelling, erythema, warmth, ligamentous laxity	Protected weightbearing with total contact casting or prefabricated pneumatic brace. Cast or brace should be used until radiographic resolution of fragmentation and presence of normal skin temperature (usually needed for 2– 4 months).
II (Coalescence)	Osteopenia, fragmentation, joint subluxation or dislocation	Decreased warmth, decreased swelling, decreased erythema	Total contact casting, prefabricated pneumatic brace, Charcot restraint orthotic walker, or clamshell ankle-foot orthosis
III (Reconstruction)	Consolidation of deformity, joint arthrosis, fibrous ankyloses, rounding and smoothing of bone fragments	Absence of warmth, absence of swelling, absence of erythema, stable joint ± fixed deformity	Plantigrade foot: custom inlay shoes with rigid shank and rocker bottom sole. Nonplantigrade foot or ulceration: de´bridement, exostectomy, deformity correction, or fusion with internal fixation

Table 2: Anatomical classification of COA.[9]

Anatomical classification of charcot osteoarthropathy	
Pattern	**Foot joints involved**
I	Metatarsophalangeal and interphalangeal joints
II	Tarso-metatarsal (Lisfranc's) joints
III	Naviculocuneiform, talonavicular and calcaneocuboid joints
IV	Ankle and subtalar joints
V	Calcaneum

As a member of the TNF superfamily, RANKL is the ligand that activates the receptor of NF-kB (RANK).

The activation of RANK stimulates the intracellular pathways that end up by formation of nuclear transcription factor NF-kB. The expression of NF-kB induces osteoclast precursor cells to differentiate into mature osteoclasts.[3,9]

Thus, NF-kB pathway is implicated in the excessive osteoclastic activity in diabetic Charcot arthropathy along with its involvement in many conditions that manifest with osteolysis including glucocorticoid-induced osteoporosis, metastatic malignancy, periodontitis, prosthesis-related osteolysis, and rheumatoid arthritis.[19]

RANKL activity is antagonized by Osteoprotegerin (OPG), a soluble glycoprotein decoy receptor for RANK ligand which effectively neutralizes its effects. OPG's expression is induced by NF-kB, as a self-limiting agent of its proinflammatory function. The patients with Charcot arthropathy displayed elevated RANKL/OPG ratios fuelling the progression of the inflammation.[3,10,11] Osteoclasts play a key role in the course of Charcot arthropathy as executer cells, responsible for imbalanced bone turnover and eventually osteolysis. With high levels of proinflammatory cytokines, monocytes stimulate T lymphocytes in an exaggerated way.

In addition to this, monocytes obtained from Charcot patients present reduced secretion of anti-inflammatory cytokines, and increased resistance to apoptosis.[3,10,12]

Clinical examination

The patient usually presents with swelling, erythema, and increased warmth of the involved foot and ankle. Cardinal signs of inflammation are crucial since inflammation plays a key role in the pathophysiology of COA. A more detailed progress classification scheme has been introduced by Eichenholtz and has been modified by Shiba et al as shown as (Table 1).

COA also can be classified into five different patterns according to the involvement of several foot joints (Table 2).

Radiographic features

Plain radiographs may initially be negative, for a few days up to three weeks, and the only finding in acute COA may be soft tissue swelling. However, as the disease progresses, radiographic features appear, as shown in (table I). Osteophytes, subchondral sclerosis and narrowing of joint spaces are often seen in radiographs.[14] The X-ray finding depends on the specific type of COA.

Bone scintigraphy

Bone scintigraphy is very sensitive but not specific enough for the diagnosis of COA. Bone scan can be positive in all phases. Thus, differential diagnosis from osteomyelitis is difficult as increased bone turnover characterizes both entities. It has been suggested that the combination of technetium-99m methylene diphosphonate scintigraphy with indium-111-labeled leukocyte scintigraphy may improve sensitivity (93-100%) and specificity (almost 80%) in the differential diagnosis from osteomyelitis.[2,15]

Magnetic resonance imaging

MRI is a powerful, non-invasive tool for determining the presence or absence of osteomyelitis in the diabetic patient. MRI is an effective technique for distinguishing between osteomyelitis and chronic neuropathic osteoarthropathy. The location of the disease is an important factor in differentiating between infection and neuropathic osteoarthropathy. MRI is valuable both for the differential diagnosis from osteomyelitis and for the detection of superimposed osteomyelitis on pre-existing COA.[2,16]

Treatment

Non-surgical treatment

Off-loading is essential when acute COA is suspected, even if not proven, in order to prevent disease progression and foot deformity. This method is based on immobilisation and the complete absence of weight bearing for the affected extremity in the active stage. In stage I of Charcot foot disease, non-weight-bearing of the affected limb allows healing of joint fractures. The gold standard of off-loading is the total contact cast (TCC). The TCC is usually necessary for 2 to 4 months. To prevent recurrence or ulceration on subsequent deformities, various devices are recommended after an acute or active episode has resolved, including prescriptive shoes, boots, or other weight-bearing braces.[4]

Pharmacological treatment

Bisphosphonates and calcitonin have been used in the treatment of COA. The bisphosphonate has been used to in-hibit osteoclast activity. although there was no follow-up data on the degree of deformity, Short-term results are promising but these agents are not yet recommended for routine use.[21,22]

Calcitonin may have some advantageous effects in comparison with bisphosphonates. Bisphosphonates can cause total inhibition of calcifying colony forming units contrary to the cessation of the osteoclast bone resorption by calcitonin, which was not accompanied by a decreased activity of osteoblasts. For these reasons, it might be logical to consider treating patients with calcitonin rather than bisphosphonates.[23]

Recently, new anti-inflammatory therapeutic agents such as corticosteroids, TNF-α antagonists (infliximab, etanercept) and RANK-L antago¬nists (denosumab) have been proposed but further research is needed.[24]

Surgical treatment

Surgery has generally been avoided during the active inflammatory stage because of the perceived risk of wound infection or mechanical failure. However, Surgery has been recommended for resecting infected bone (osteomyelitis), removing bony prominences that could not be accommodated with therapeutic footwear or custom orthoses, or correcting deformities that could not be successfully accommodated with therapeutic footwear, custom ankle foot orthoses, or a Charcot Restraint Orthotic Walker. There are various surgical interventions that used to treat COA such as exostectomy, achilles tendon lengthening, and arthrodesis.[2,20,25,26] Amputation is unavoidable when surgery fails due to recurrent ulceration/infection or unstable arthrodesis.[2,27]

In this case, we confirmed the diagnosis of COA by clinical and radiological examination. We found that the patient was not aware of any microtrauma due to loss of protective sensation in the foot, we also found the occurrence of rocker bottom deformity, when the midfoot is involved in Charcot foot, the arch collapses, and the foot takes on an abnormal shape which rounds the bottom of the foot creating a rocker-bottom foot deformity. There is an absence of warmth, swelling and erythema. Radiological examination shows destruction of caput metatarsal I and soft tissue swelling with scalloping cortex phalanx distal I. According to Eichenholtz classification, this patient was in stage III. Surgical treatment was considered for mainly in chronic cases with joint instability or severe deformity.[2] Surgical treatment is beneficial in CN cases refractory to offloading and immobilization or in the case of recalcitrant ulcers and generally been avoided during the active inflammatory stage because of the perceived risk of wound infection.[4] Surgical treatment mostly based on professional opinion. We realized that our hospital has limited facilities and instruments, some radiographic features such as MRI, Bone scintigraphy and surgical approach like exostectomy, achilles tendon lengthening, and arthrodesis cannot be implemented. however, surgical debridement is

performed to prevent further infection that can progress to a worse outcome.

CONCLUSION

The charcot joint osteoarthropathy is a severe complication of diabetes and neuropathy. Its destructive effects on the foot and ankle are caused by uncontrolled inflammation. Increased clinician alertness is required for the early detection in every diabetic patient with peripheral neuropathy who presents with a red, hot, swollen foot, and virtual absence of pain may help differentiate this condition from others like cellulitis, trauma or sprain, acute gout, or deep vein thrombosis. Treatment of COA depends on many factors including clinical stage, location of involvement, degree of deformity and patient comorbidities. Even when the diagnosis is only suspected, immediate immobilization and off-loading is the wisest practice. antiresorptive therapies such as bisphosphonates and calcitonin have been used in the pharmacological treatment of COA. Surgery is usually reserved for chronic cases with severe deformity or joint instability. Early detection and diagnosis of COA can lead to rehabilitation of such patients and may even prevent the worst possible outcome.

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