

Mortality Rates in Patients with Charcot's Foot: Review of Literatures

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ABSTRACT

Background: Diabetes mellitus (DM) is considered a frequent metabolic disorder and its prevalence in adults has been increasing in the last years. Charcot neuroarthropathy is considered a main etiology of morbidity among diabetic cases with subsequent joint destruction, which ends ultimately in deformity. The mortality in cases with Charcot foot was more than expected. However, there were no differences among cases with Charcot and cases with uncomplicated neuropathic ulcers.

Objective: This study aimed to investigate the mortality rate in patients with Charcot's foot.

Material and methods: A PubMed search was done with the key words "Charcot foot, Diabetes, Mortality, CKD, IHD" We could trace about 1000 papers on the subject. Electronic database was systematically searched for literature discussing the Epidemiology, Pathogenesis, Clinical features, and Investigations, Management and Prognosis of Charcot neuroarthropathy. We applied no restrictions on publication date. Article eligibility was assessed independently by all authors. Reasons for exclusion of articles based on title or abstract were (1) nonoriginal data (e.g., editorials, guidelines, and comments), (2) nonclinical articles (e.g., technical or animal studies), (3) case reports, and (4) articles not written in English language. All authors independently chose the most relevant papers with regard to target topics resulting in the identification of 25 "most pertinent" articles.

Results: Diabetic cases with Charcot foot were more susceptible for mortality compared to Charcot foot free ones. The actual mechanism of such association was unknown, however it could be explained by the fact that cases with foot ulcers were at a high possibility for PVD and macrovascular diseases development compared to cases with CA with a subsequent higher mortality rates. Another possible mechanism is the existence of ulceration which raises the possibility of infections, with a subsequent increase in the possibility of complications which may ultimately end in death

Conclusion: Physicians should take into consideration, ACN in all cases complaining from warm red joint together with neuropathy. The backbone of diagnosis is still clinical however MRI and isotope bone scanning could be considered also as early diagnostic modalities. Very early management could possibly prevent limb-threatening deformity so encourage investigations and management is of great importance.

Keywords: Diabetes, Charcot foot, Mortality, CKD, IHD.

INTRODUCTION

Diabetes mellitus is a disease of improper control of blood levels of glucose. It could be classified into several classifications, such as type I, type II, gestational diabetes mellitus, neonatal diabetes and steroids-induced DM⁽¹⁾. Worldwide, the number of diabetic cases is increased by about four folds in the past three decades, and DM is considered the 9th main etiology of death. Approximately 1 out of 11 adults have DM, 90% of whom have T2DM⁽²⁾. The rising number of diabetic cases was demonstrated to be associated with an increase in co-morbidities which involve microvascular and macrovascular adverse events⁽³⁾.

Charcot neuroarthropathy

Charcot neuroarthropathy (CN) is identified for over 130 years and yet it is still a main etiology of morbidity for diabetic cases and a continuing challenge for specialists. The primary etiology is believed to be traumas in a neuropathic foot that was demonstrated to be accompanied by complicated sequences of pathologic

events culminating in bone and joint destructions, which ultimately ends in deformity development⁽⁴⁾.

It is considered a devastating adverse event affecting diabetic cases as well as peripheral neuropathy (PN). It is considered as progressive and destructive state featured by acute fractures, dislocations and joint destructions in the neuropathic foot. Rapid diagnosis and treatment of acute Charcot neuroarthropathy (ACN) is thus essential to evade the abrupt development of permanent feet deformation as well as its accompanying adverse events⁽⁵⁾.

The acute reaction is occasionally misdiagnosed and a lot of cases present late with deformity. Although when the diagnosis is taken into consideration at an initial phase, no conclusive criteria could establish Charcot neuroarthropathy development and a higher degree of suspicion is of great importance for any diabetic patients with a swollen warm foot⁽⁶⁾.

Epidemiology:

Till now, there are no epidemiologic researches in the context of CN. The recorded prevalence CN is about



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2.5% of diabetic cases. About 101 cases were detected between 68000 successive diabetic cases between 1947 and 1970, giving a frequency of 1:680. CN changes were detected in 1.4% in another research of foot radiographs of 456 diabetic cases ⁽⁷⁾.

Most of cases with CN present between the 5th and 6th decades and most of them had DM for at least 10 years. New surveillance has exposed Charcot neuroarthropathy to be allied with early death ⁽⁴⁾.

Pathogenesis:

The Charcot neuroarthropathy process is possibly activated by traumas in most of cases. It is believed to be associated with abnormalities in terms of vascular reflex with a consequent increase in bony blood flow owing to autonomic dysfunctions, maybe it similar to the process detected in reflex sympathetic dystrophy ⁽⁸⁾.

Clinical features:

Acute presentation:

In the context of ACN, there is often moderate pain and edema although the feet may be totally insensate. In addition, there might be a history of traumas however this is under-reported owing to the absence of accompanying pain. In the context of clinical examination, the foot is warm, swollen, tender and erythematous. At this phase the differential diagnosis involves cellulitis, hyperuricemia and DVT as well as osteomyelitis. Unfortunately, owing to the scarcity of CN, the first diagnosis is usually ignored inducing a delay in identification of CN and subsequent deformities ⁽⁹⁾.

Chronic CN:

Chronic CN is featured by the development of deformities. Mid-foot CN, the most frequently noticed CN was demonstrated to be associated with collapsing of the arch which ultimately ends in rocker-bottom deformities. There is often abnormality in pressure on the weight bearing areas on the plantar aspect with accompanying callus formation that triggers ulcer development ⁽¹⁰⁾.

Complications:

- Foot deformities like flatfoot, ankle equinus contracture and hammertoes.
- Bony prominences that could be accompanied by ulceration, infections, and in certain cases amputation or even death.
- Recurrence of Charcot joint ⁽¹¹⁾.

Investigations:

Charcot neuroarthropathy diagnosis could be hard and the discrimination of infections from rapid onset CN is still a main problem in a minor ratio of cases. There is no conclusive confirmatory test but the proper utilization of various isotope scans and MRI could help diagnose CN and assess the disease progression as well as the response to therapy. In addition, combined isotope scanning could

offer a very precise diagnosis. The radiological investigations have to be conducted in close liaison with a radiology specialist who should be completely aware of the limitation of all radiological modalities ⁽¹²⁾.

Management:

Acute CN:

The objectives of management are to stop the acute process to avoid permanent deformity development and to alleviate pain. Plans for prevention of the limb from weight bearing are the main therapeutic line of treatment of ACN. A lot of researches displayed the advantage of specialized foot wear in ACN. Following immobilization in a plaster cast, various kinds of footwear are utilized. Total contact bivalve ankle-foot orthoses are utilized efficiently ⁽¹³⁾.

Chronic Charcot neuroarthropathy:

The objectives of treatment of the chronic stage of CN are to reduce plantar pressures, conserve skin integrity and offer a stable foot. The majority of cases need adaptation of foot wears in order to accommodate their deformity in association with total contact insoles. Stabilization of the feet and modification of weight-bearing by the usage of rocker soles might aid to manage the possibility of recurrent ulcers. Correction of deformities by surgeries is utilized with different outcomes in chronic CN. Approaches which include arthrodesis, exostectomies, reconstruction and Achilles tendon lengthening are conducted ⁽¹⁴⁾.

In proper cases a simple approach, which include removal of abnormally weight-bearing bone could permit the usage of proper footwear and decrease the possibility of more feet ulcers ⁽¹⁵⁾.

Prognosis:

It was demonstrated that the resolution time of acute Charcot to progress through whole phases around 8 months. In a research carried out by **Jansen and his colleagues** ⁽¹⁶⁾, 67% of Charcot cases developed adverse events including ulcers. In addition, non-adherence to the proper lines of management was observed to significantly worsen the prognosis.

Mortality among DM and Charcot cases:

The greatest ratios of DM-related death were demonstrated to be 25.5% in South-East Asian females with an average age of 55 years old. The greatest ratio of deaths related to DM was demonstrated in nations with huge number of subjects including China, India and Indonesia. To the best of our knowledge, 1 out of 12 of global all-cause deaths was measured to be accompanied by DM in adult populations. In general, the mortality rate was slightly greater in females compared to males ⁽¹⁷⁾. The age is considered the main risk factors for mortality among

diabetic cases. In every age group, elderly with DM were accompanied by a significant increase in all-cause mortality rates compared to the general population⁽¹⁸⁾.

The mortality in cases with Charcot feet was greater than expected. However, there were no differences among cases with Charcot and cases with uncomplicated neuropathic ulcers. It might be neuropathy, instead of Charcot osteoarthropathy, independently accompanied by an increase in the mortality rates among diabetic cases. The actual mechanisms of these associations aren't well identified⁽¹⁹⁾.

The average prevalence of a study conducted by **Van Baal and his colleagues**⁽²⁰⁾ assessed the mortality of all cases with Charcot foot was 11 % at one year, 25% at three years, and 40% at 5 years. It was demonstrated that cases with a Charcot foot died at an average age of 66.5 years⁽²⁰⁾. In addition, **Engberg and his colleagues**⁽²¹⁾ conducted a major research comprising whole cases with a Charcot diagnosis at their center from 2000 to 2016. They have displayed that, 164 cases had the diagnosis Charcot (DM146) and 52 (31.1%) died throughout the follow up period. They lived for 1973 days in other words, 5.4 years.

Multivariable Cox regression was performed and showed that, in comparison with Charcot arthropathy, feet ulcers were accompanied by 35% greater mortality risk and DM only with 25% lower risk. In the context of cases with CA, 65% experienced feet ulcers irrespective of CA onset. In more detailed analysis, it was reported that, CA is accompanied by a significant increase in death rates regardless of feet ulcers and various co-morbidities. There was a shorter OS in CN cases with diabetic nephropathy; however such change did not reach the statistical significance. A major cohort of CN cases demonstrated an increase in mortality rate. Macrovascular diseases, which include PAD or CHD were demonstrated to be of great prevalence among CN affected cases in comparison with diabetic cases with no foot adverse events. The mortality risks were significantly increased among elderly. Hepatic, renal and cardiac affections were demonstrated to be the most frequently associated co-morbidities related to the mortality risk⁽²²⁾.

The incidence of ulceration among Charcot's arthropathy cases was 17% annually. The average time interval between the acute component of CA and ulcer development was 36 months. Additionally, diabetic Charcot deformities were more liable for ulceration in comparison with diabetic cases with no Charcot deformities by at least four folds⁽²³⁾.

It has been stated that Charcot osteoarthropathy affects among point one percent to point nine percent (0.1% to 0.9%) of diabetic cases. An assessed sixty three percent of Charcot neuropathic osteoarthropathy cases would progress an ulceration of the foot. Additionally, it is essential to declare that **McEwen and his colleagues**⁽⁸⁾ established an important link among Charcot arthropathy

and BMI.

An important note has to be taken into consideration, which is the fact that, why diabetic cases with Charcot foot were more susceptible for mortality compared to Charcot foot free ones. The actual mechanism of such association was unknown, however it could be explained by the fact that, cases with foot ulcers were at a high possibility for PVD and macrovascular diseases development compared to cases with CA with a subsequent higher mortality rates. Another possible mechanism is the existence of ulceration which raises the possibility of infections, with a subsequent increase in the possibility of complications which may ultimately end in death⁽²⁴⁾.

CONCLUSIONS

Charcot neuroarthropathy is becoming a frequent complication among cases with diabetic foot. Physicians should take into consideration, ACN in all cases complaining from warm red joint together with neuropathy. The backbone of diagnosis is still clinical however MRI and isotope bone scanning could be considered also as early diagnostic modalities. Very early management could possibly prevent limb-threatening deformity so encourage investigations and management is of great importance⁽²⁵⁾.

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