Charcot Neuropathic Osteoarthropathy – A review and case study

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First Described in 1883 as osteoarthropathy seen in cases of syphilis

The typical presentation of the “rocker bottom” foot
As imaging techniques improved, the extent of severity of deformity became evident.
It is now understood that many conditions can contribute to Charcot osteoarthropathy.

The underlying common denominator is peripheral neuropathy:

- Systemic disease, including diabetes mellitus, parkinsonism, HIV, psoriasis
- Nerve compression
- Cerebral palsy
- Lead poisoning
- Alcoholism
- Nerve, spinal cord trauma
- Vascular accident, PVD
- Nutrition
- Hereditary neuropathies
Diabetes mellitus is by far the most prevalent

Whether type 1 or type 2 diabetes mellitus is not a factor, however must be neuropathic

- 1% of all diabetics develop Charcot neuropathic osteoarthropathy
- Length of disease and quality of blood sugar control are prime contributing factors to developing neuropathy
- It is postulated that sensory/motor/autonomic neuropathy combined with trauma and metabolic bone abnormalities produce the acute inflammatory response
All three forms of neuropathy as contributors to the acute inflammatory response

- Sensory neuropathy results in LOPS and vibratory sensation deficit
- Motor neuropathy causes structural deformity with subsequent abnormal loading (digital contracture, drop foot)
- Autonomic neuropathy causes changes in skin structure further contributing to LOPS
Some form of trauma often involved with starting the destructive process

- Often minimal event as perceived by the patient, shrugged off as insignificant
- Neuropathy always present, making the symptoms less apparent to the patient because of less pain
- Surgical intervention is a traumatic event that has been shown to be a contributing factor
If pain is present, it is far less than the severity the acute clinical presentation suggests, however....

Pain is consistently the most frequent presenting complaint with acute Charcot arthropathy
- Armstrong et al.
Clinical differential diagnosis in Charcot osteoarthropathy

- Inflammatory arthropathy
- Trauma
- Infection, cellulitis
- Deep Venous Thrombosis

- The clinician should consider Charcot osteoarthropathy in the neuropathic patient as the primary diagnosis if there is a sudden onset of swelling, erythema, local unilateral temperature increase of several degrees and strong pedal pulses
In all cases the earliest possible diagnosis is crucial to reduce deformity, although significant deformity in most cases is inevitable.
Two clinical staging protocols commonly used with Charcot Osteoarthropathy

**Eichenholz classification**
- Stage 1 – acute, development stage – marked erythema, swelling, warmth
- Stage 2 – subacute, coalescence stage – decreased erythema, swelling, warmth
- Stage 3 – chronic, reconstruction stage – consolidation, swelling, no heat or erythema

**Rogers et al. classification**
- Active stage – acute
- Inactive stage – chronic
Imaging in the diagnosis of Charcot osteoarthropathy

During stage 1, if x-rays are negative, serial radiographs may be necessary to confirm the diagnosis.

If radiographs are inconclusive, MRI is the gold standard.
Imaging in the diagnosis of Charcot osteoarthropathy

- Osteomyelitis must be ruled out when structural deformity and ulceration are present
- Late stage 2, stage 3
- Radioisotope labeled white blood cell bone scan helpful in this case
Imaging in Charcot osteoarthropathy

Five anatomical levels of bone and joint destruction are recognized

- **Type 1** - Digits, MTPJ’s; less frequently seen
- **Type 2** – Midfoot, metatarsal/cuneiform, cuneiform/navicular; most frequent presentation
- **Type 3** – Hindfoot/midfoot collapse; second most frequent
- **Type 4** – Ankle
- **Type 5** – Subtalar joint
Imaging in Charcot osteoarthropathy

Radiographic findings show two distinct patterns

**Atrophic**
- Type 1 anatomical level
- Less frequent
- Non-weight bearing target sites
  - phalanges, interphalangeal and metatarsal phalangeal joints

**Hypertrophic**
- Types 2-5 anatomical levels
- Most frequently seen
- Weight bearing target sites
  - metatarsal/cuneiform, cuneiform/navicular, talonavicular joints
Imaging in Charcot osteoarthropathy

Atrophic presentation characterized as osteolytic

- Early stage – increased soft tissue density, subluxation, metaphyseal cortical defects
- Progressive stage – cortical defects less defined, erosions, osteolysis, periosteal reaction, fragmentation
- Late stage – metaphyseal narrowing, ankylosis

Hypertrophic presentation more classic radiographic findings

- Stage 1 – increased soft tissue density, extra – articular debris, subchondral fragmentation, fractures, subluxation
- Stage 2 – osteophyte formation, fusion, sclerosis, mottled appearance, reduction in soft tissue density increase
- Stage 3 – decreased sclerosis due to increased vascularity, residual deformity
The worst case scenarios of Charcot osteoarthropathy are amputation and ulceration.

Multiple factors contribute to foot ulcer formation, which is the primary portal of osteomyelitis development:

- Residual deformity inappropriately treated
- Ankle equinus causing increased forefoot weight bearing and lever arm with increased plantar mid-foot pressure
- Continuous, concentrated high pressure and repetitive mechanical stress combined with inappropriate offloading
- Thermal injury
- Ischemia
- Blood sugar control
- Skin infection
Charcot osteoarthropathy treatment

Determined by Eichenholz stage presentation

Non surgical treatment

- **Stage 1**, early stage 2
  - Below the knee cast every 7 – 10 days until the cutaneous temperature is within 2 degrees F of the contralateral foot and clinical symptoms improve.
  - Prefabricated, removable cast modified as a “instant total contact cast” - Armstrong, et al.
  - 50% of clinicians prefer non-weight bearing status

- **Stage 3**
  - Custom orthosis
  - Therapeutic shoes (sometimes custom made with foot bed excavation)
  - Weight bearing braces (Charcot restraint walker, AFO, custom molded drop foot brace, patellar tendon bearing brace)
  - Appropriate wound care/infection management if ulceration
  - Patient education
  - Lifetime surveillance
Charcot osteoarthropathy treatment

Surgical treatment

- Typically in stage 3 due to mechanical failure of fixation if done earlier
- Non union, loss of correction not uncommon due to loss of bone stock
- Goal is to restore a plantar grade foot to prevent ulceration, reduce recurrence, and improve ambulatory mechanics
- Increasing trend toward preemptive surgical intervention
- “Super construct“ concept during surgery with fixation extended proximal and distal to deformity for greater internal stability
Charcot osteoarthropathy treatment

Surgical treatment

- Procedure determined by extent of deformity
- Staging often indicated
- Resection of infected bone
- Removal of bony prominences
- Reconstruction by reduction of deformity, internal and/or external fixation of fractures
- Fusion of disarticulation
- Tendoachilles lengthening or gastrocnemius recession for midfoot offloading, often done prior to osseous correction
- Type 4 anatomical presentation (ankle) surgical intervention primary choice as non-surgical treatment usually results in unstable fibrous union
Surgical treatment of Charcot Osteoarthropathy
Charcot osteoarthropathy

Case study #1

- 55 y/o caucasian male, well nourished, well groomed, well oriented. BP 140/86, 220 lbs., 6 ft. 2 in.
- Type 2 diabetes mellitus, 17 years duration.
- Metformin, losartan/HCT, pravastatin
- No history of nephropathy, retinopathy
- Blood sugar fluctuates, control difficult, Ha1-C 7.2
- Dorsalis pedis ¾, posterior tibial ¾
- Symes – Weinstein filament testing absent distal to heels, vibratory sensation reduced
- Semi – rigid hammertoes, partial subluxation of MTPJ’s, forefoot hyperkeratosis
- Custom orthotics, therapeutic shoes, regular hyperkeratosis debridement
Wagner diabetic foot ulcer grading

- Grade 1 – Superficial diabetic foot ulcer
- Grade 2 – Ulcer extension to ligament, tendon, joint capsule, fascia, no abscess or osteomyelitis
- Grade 3 – Deep ulcer with abscess or osteomyelitis
- Grade 4 – Gangrene to portion of forefoot
- Grade 5 – Extensive gangrene of foot
Charcot osteoarthropathy

Case study #1, the best laid plans........

- Developed Wagner scale grade 3 right forefoot ulceration, regressed to grade 4, second and third ray resection
- Developed type 2 acute Charcot process left foot, treated with total contact cast to resolution
- Resulted in stage 3 plantar mid foot deformity
- Subsequently developed Wagner scale grade 2 left midfoot ulceration even with appropriate offloading
- Wound care 3 months to closure, with repetitive events of re-ulceration
- Mid foot reconstruction surgically
- Developed Wagner scale grade 2 ulceration plantar and dorsal lateral left mid foot secondary to improperly fitting CROW walker post operatively
- Ulcer closure achieved in 6 weeks with Grafix skin substitute and total contact casting
Charcot osteoarthropathy

Case study # 1

Grade 2 ulceration, plantar, dorsal lateral
Charcot osteoarthropathy

Case study #1

Grafix application
Charcot osteoarthropathy

Total contact casting
Ulceration healed
Charcot osteoarthropathy

Case study # 2

- 45 y/o, caucasian male, well oriented, well groomed, well nourished, BP 130/88, 180 lbs., 5 ft. 10 in.
- Sensory neuropathy of unknown origin, no history of diabetes mellitus
- Dorsalis pedis ¾, posterior tibial 2/4
- Simvastatin
- Severe hallux valgus, contracted second toe, plantar grade displaced second metatarsal, plantar grade foot structure
- Patient did not seek treatment during stage 1
- Presented with deep ulceration and abscess under second metatarsal phalangeal joint probing to bone, of 1 month duration
- Edema without erythema, no local temperature increase or pain, metatarsal/cuneiform level of at least 6 months duration, x-rays at that time show changes consistent with stage 2 Charcot process or osteomyelitis
- MRI, positive indium WBC scan confirmed osteomyelitis at second metatarsal, no indium labeled WBC accumulation at mid foot confirming Charcot process rather than osteomyelitis
Charcot osteoarthropathy

Case study # 2

Surgical intervention for osteomyelitis second metatarsal
Charcot Osteoarthropathy

Comments regarding case #2

• Initial radiographs suggested Charcot process prior to any forefoot skin defect or infection with MRI confirmation
• WBC bone scan done to assess extention of metatarsal osteomyelitis, was also suggestive for osteomyelitis at area of Charcot arthropathy
• During surgery affected bone in this area was curetted and packed with gentamycin beads as an infection precaution
• The patient has not yet regressed to Stage 3, wearing orthotics preventatively
• Bunion correction is urgent as he is preulcerative at medial aspect of 1st MTPJ
Thank You