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"Treatment of Charcot Neuroarthropathy and Osteomyelitis of the Same Foot: A Retrospective Cohort Study." – A Brief Review

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Abstract

A brief review of the above-mentioned article: forty patients with 43 affected feet and 60 cases of osteomyelitis were included in this study. They were split into two groups, one with osteomyelitis outside and another one with osteomyelitis within the active Charcot region. The results showed that the amputation rate did not differ between the two groups, although in group 1 – osteomyelitis outside the active Charcot region.

amputations were exclusively performed at the forefoot and in group 2 – with osteomyelitis within the active Charcot region – exclusively in the mid- and hindfoot. Amputations in group 2 were, therefore, more high level. The duration of immobilization and antibiotic treatment was significantly longer in group 2. We conclude, that patients treated for osteomyelitis in an active Charcot foot should be considered and treated as separate entities, depending on whether the osteomyelitis is located within or outside the active Charcot region. If osteomyelitis occurs outside the active Charcot region, primary amputation may be preferred to internal resection.

Introduction

The Charcot – or neuroosteoarthropathic – foot is the final form of a neuropathic foot, which ends in severe deformity and bony destruction[1-3]. Since the most frequent cause of the neuropathy is long-term diabetes mellitus, it is often also called diabetic neuroosteoarthropathy (DNOAP)[4], which is not entirely correct, as several other reasons for neuropathy exist, such as toxins (e.g. alcohol, chemotherapy), deficits of vitamin B12 or folic acid, etc. Neuroarthropathy of the foot was first described by Jean-Martin Charcot (1825-1893) a French neurologist, who worked at the Hôpital de la Pitié-Salpêtriére in Paris[5].

The classic symptoms of the disease are redness, warmth and swelling, but – due to the neuropathy – lack of pain. Neuropathy is also the main reason why deformity may develop, as the patient continues to fully weight bear despite an increasing fragility of the bones. Underneath the aforementioned symptoms, the bones become osteopenic and fracture, which may lead to the final shape of the foot, the so-called rocker-bottom deformity. Due to the bony prominences, this shape of the foot is prone to ulcerations and infection. With the ulcerations, there is an increasing risk of infection and – if they are not treated quickly and appropriately – amputation.

Osteomyelitis is one of the main differential diagnoses of the Charcot foot. The central diagnostic tool during treatment of the Charcot foot is magnetic resonance imaging (MRI). It is very difficult to differentiate an active Charcot foot from osteomyelitis. The situation becomes even

more difficult if one is dealing with an infected Charcot foot. For this reason, we decided to review our cases of infected Charcot feet, in order to find a pattern and possibly identify treatment recommendations to reduce the number of patients undergoing septicemia or amputation[6,7].

Methods

Patients who were treated for Charcot foot and osteomyelitis between 2002 and 2012, were selected from our electronic hospital patient data collection. Inclusion criteria were: a diagnosis of Charcot neuroarthropathy (CN) according to the definition and diagnostic criteria of the French neurologist J.M. Charcot, radiographs of the affected foot, and osteomyelitis of the same foot, which was confirmed with radiological findings of osteomyelitis on MRI, positive bone biopsy cultures, and blood tests (i.e., C-reactive protein). Exclusion criteria were: primary treatment at another institution, or a previous fracture due to trauma of the same foot.

This study included 40 patients with 43 affected feet and a total of 60 cases of osteomyelitis. According to the localization of the osteomyelitis, the cases were divided into two groups: group 1 with osteomyelitis outside the active Charcot region, and group 2 with osteomyelitis within the active Charcot region. Each group consisted of 30 cases: group 1 (osteomyelitis outside the active Charcot region) included 22 patients with 23 affected feet; group 2 (osteomyelitis within the active Charcot region) included 23 patients with 24 affected feet; 5 patients had both, episodes of osteomyelitis outside and within the active Charcot region.

Logistic regression analysis was performed to address clustering of cases within patients, with amputation as the dependent variable and localization of osteomyelitis as the independent variable. Durations of antibiotic therapy and immobilization were calculated in days and analyzed as logarithmic transformed dependent variables in linear regression with robust standard error (i.e., patient identification as a cluster).

Results

We demonstrated that patients in group 2 (osteomyelitis within the active Charcot region) had a longer duration of antibiotic treatment, with a mean of 84.1 ± 51.2 (range 6-236) days[8,9]. In contrast, group 1 (osteomyelitis outside the active Charcot region) was treated with antibiotics for a mean of 55.7 ± 48.9 (range 9-228) days (Table 1) (p = 0.045).

Table 1: Synopsis of all patient demographic characteristics and treatment

ID	Side	Age	Gender	Sanders	Osteomyelitis	Osteomyelitis Location	Antibiotic Treatment (days)	Initial Surgical Treatment	Immobilization (days)	Treatment Duration (days)	Amputation
1	right	55.3	male	4	outside	forefoot	41	amputation	41	44	Transmetatarsal
	right	56.0		4	outside	forefoot	21	amputation	129	129	Toe
2	right	63.7	male	1	Charcot	midfoot	60	limited resection	63	61	
3	left	84.8	female	1	Charcot	forefoot	35	amputation	29	256	Transmetatarsal
4	left	65.1	male	3	outside	forefoot	30	amputation	32	76	Toe
	left	68.1		3	outside	forefoot	115	amputation	74	194	Toe
5	right	44.7		3	outside	midfoot	122	none	na	230	
6	right	77.3	female	2	Charcot	midfoot	130	debridement	na	100	
	right	78.8		2	Charcot	midfoot	120	debridement	na	245	
	right	79.2		2	Charcot	midfoot	80	debridement	na	80	Transtibial
7	left	44.5	male	4	Charcot	hindfoot	107	arthodesis	83	124	
	left	45.7		4	Charcot	hindfoot	134	arthodesis	101	57	
	left	48.5		4	outside	forefoot	15	amputation	22	186	Toe
	right	46.8		4	outside	forefoot	24	none	na	50	
	right	47.8		4	Charcot	hindfoot	35	arthodesis	120	143	
8	left	62.2	female	2	outside	forefoot	70	limited resection	60	287	
9	left	46.6	male	2	outside	forefoot	50	none	82	76	
10	left	51.0	male	4	Charcot	hindfoot	152	amputation	389	512	Transtibial
11	right	42.9	male	3	Charcot	hindfoot	118	debridement	290	97	
	right	46.1		3	Charcot	hindfoot	75	arthodesis	195	917	
12	left	82.2	female	1	Charcot	forefoot	67	limited resection	139	175	
13	left	63.3	male	2	Charcot	midfoot	58	amputation	115	309	Lisfranc

14	left	46.9	male	2	Charcot	midfoot	238	limited resection	na	795	Transtibial
15	left	69.9	male	2	Charcot	midfoot	57	limited resection	266	353	
16	right	57.9	male	1	Charcot	forefoot	75	amputation	135	247	Toe
17	right	55.6	male	2	outside	forefoot	34	amputation	43	56	Transtibial
18	right	71.3	male	4	outside	forefoot	72	limited resection	20	99	
	right	73.0		4	outside	forefoot	48	amputation	26	73	Toe
19	right	74.4	female	2	outside	forefoot	37	amputation	19	204	Toe
20	right	60.3	male	2	Charcot	midfoot	173	debridement	142	181	
21	left	51.4	female	1	Charcot	forefoot	24	limited resection	na	51	
	left	53.1		1	Charcot	forefoot	57	amputation	na	850	Toe
	left	56.3		1	Charcot	forefoot	49	amputation	na	1070	Toe
22	left	56.0	male	2	Charcot	forefoot	147	limited resection	144	231	
22	left	56.1	male	2	outside	forefoot	181	limited resection	48	78	
23	right	73.8	male	1	Charcot	forefoot	49	arthodesis	99	803	
24	left	46.1	male	2	Charcot	midfoot	78	debridement	68	85	Chopart
25	right	69.2	male	2	Charcot	midfoot	121	limited resection	104	1320	
	right	75.4		2	outside	forefoot	9	amputation	63	85	Toe
26	left	63.5	male	2	outside	forefoot		amputation	39	120	Toe
	left	65.8		2	outside	forefoot	51	amputation	87	87	Transmetatarsal
	right	68.5		2	Charcot	midfoot	74	limited resection	286	132	
27	right	40.1	male	2	outside	forefoot	40	limited resection	57	109	
	right	40.6		2	outside	forefoot	40	limited resection	60	1128	
28	left	77.5	male	2	outside	forefoot	52	limited resection	na	62	
	left	78.5		2	outside	forefoot	59	amputation	na	116	Toe
29	right	61.1	male	2	outside	forefoot	28	amputation	37	1315	Toe
30	left	61.5	female	1	Charcot	forefoot	45	limited resection	17	58	
31	right	58.1	female	3	Charcot	hindfoot	90	arthodesis	131	1147	Transtibial
32	left	52.6	male	2	outside	forefoot	48	limited resection	177	491	Transtibial
33	right	61.3	male	5	Charcot	hindfoot	23	amputation	181	216	Transtibial
34	right	64.3	male	2	Charcot	midfoot	6	amputation	82	212	Transtibial
	left	67.0		2	outside	forefoot	228	limited resection	228	69	
35	left	71.4	male	3	Charcot	midfoot	45	limited resection	na	245	
36	right	66.1	male	2	outside	forefoot	37	amputation	304	304	Toe
37	left	45.9	male	2	outside	forefoot	59	limited resection	150	721	
38	right	87.5	female	3	outside	forefoot	26	limited resection	96	205	Transfemoral
39	left	54.1	female	3	outside	forefoot	19	amputation	na	61	Toe
	left	54.6		3	outside	forefoot	33	amputation	101	137	Transmetatarsal
40	left	80.9	female	2	outside	forefoot	27	amputation	na	48	Toe

The duration of immobilization, which was achieved with a total contact cast[10] was also extended in group 2 (mean 144 ± 91.8, range 17-389 days) compared to group 1 (mean 83.1 ± 70.5, range 19-304 days; p = 0.01).

The overall amputation rate was statistically similar for both groups (p = 0.09), with 19 amputations (63%) in group 1 (osteomyelitis outside the Charcot region) and 12 amputations (40%) in group 2 (osteomyelitis within the Charcot region). However, patients in group 2 underwent significantly more high level amputations compared to patients in group 1 (p = 0.009). A major amputation (above the ankle) was performed in 6/30 (20%) cases in group 2 and in 3/30 (10%) cases in group 1.

Discussion

Significant differences in the amputation level ($p<0.001$), duration of antibiotic treatment ($p=0.045$), and duration of immobilization ($p =0.01$) were observed between the groups, which presented with osteomyelitis within the Charcot region versus outside the Charcot region. In the group with osteomyelitis outside the active Charcot region, the elimination of infection amputation could be achieved more quickly, since the affected area could be clearly defined. However, when osteomyelitis is localized within the active Charcot area, it is more difficult to correctly define the borders of the osteomyelitis, due to the bone edema caused by the Charcot disease, which may lead to the risk of too much bone being resected. For this reason, an extended duration of immobilization combined with antibiotic therapy is considered the treatment of choice if the osteomyelitis is located within the active Charcot zone.

The infection was considered to be cleared when inflammatory markers (i.e., C-reactive protein), MRI, and the clinical appearance of the foot, were all within normal parameters again. This was also confirmed with regular follow-up visits, to allow for immediate intervention in case of a reappearance of inflammation or signs of infection.

We concluded that patients treated for osteomyelitis in an active Charcot foot should be considered as separate entities when considering treatment protocols and in future research evaluating outcomes, depending on whether the osteomyelitis is located within or outside the active Charcot region. If osteomyelitis occurs outside the active Charcot region, primary amputation may be preferred to internal resection. Additional research in the form of prospective studies would be beneficial to compare the outcomes of internal resection versus amputation when osteomyelitis occurs outside the active Charcot region.

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