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ORIGINAL RESEARCH

In inflammatory myopathies, dropped head/bent spine syndrome is associated with scleromyositis: an international case-control study

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ABSTRACT

Background Some myopathies can lead to dropped head or bent spine syndrome (DH/BS). The significance of this symptom has not been studied in inflammatory myopathies (IM).

Objectives To assess the significance of DH/BS in patients with IM.

Methods Practitioners from five IM networks were invited to report patients with IM suffering from DH/BS (without other known cause than IM). IM patients without DH/BS, randomly selected in each participating centre, were included as controls at a ratio of 2 to 1.

Results 49 DH/BS-IM patients (DH: 57.1%, BS: 42.9%) were compared with 98 control-IM patients. DH/BS-IM patients were older (65 years vs 53 years, $p<0.0001$) and the diagnosis of IM was delayed (6 months vs 3 months, $p=0.009$). Weakness prevailing in the upper limbs (42.9% vs 15.3%), dysphagia (57.1% vs 25.5%), muscle atrophy (65.3% vs 34.7%), weight loss (61.2% vs 23.5%) and loss of the ability to walk (24.5% vs 5.1%) were hallmarks of DH/BS-IM ($p\leq 0.0005$), for which the patients more frequently received intravenous immunoglobulins (65.3% vs 34.7%, $p=0.0004$). Moreover, DH/BS-IM patients frequently featured signs and/or complications of systemic sclerosis (SSc), fulfilling the American College of Rheumatology/European Alliance of Associations for Rheumatology criteria for this disease in 40.8% of the cases (vs 5.1%, $p<0.0001$). Distribution of the

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Inflammatory myopathies (IM) have been diagnosed in patients with dropped head (DH) or bent spine (BS, also referred to as 'camptocormia') syndrome, but no studies have compared IM patients with and without DH/BS. Thus, the significance of this peculiar distribution of muscle weakness in IM is currently unknown.

WHAT THIS STUDY ADDS

⇒ IM patients with DH/BS have a delayed diagnosis, older age, severe atrophying muscle involvement prevailing in the upper limbs, loss of walking ability, dysphagia, systemic signs of systemic sclerosis and mortality.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ DH/BS is a marker of IM severity associated with scleromyositis diagnosis that has important consequences for patient management.

myopathy, its severity and its association with SSc were independently associated with DH/BS ($p<0.05$). Mortality was higher in the DH/BS-IM patients and loss of walking ability was independently associated with survival ($p<0.05$).

Conclusion In IM patients, DH/BS is a marker of severity and is associated with SSc (scleromyositis).

INTRODUCTION

Inflammatory myopathies (IM) are rare systemic diseases characterised by myopathy with evidence of inflammation-driven muscle lesions. They encompass a heterogeneous group of diseases, some of which have been identified based on clinical, serological and pathological features.¹ The 2017 European Alliance of Associations for Rheumatology/American College of Rheumatology (EULAR/ACR) classification criteria recognise dermatomyositis (DM), sporadic inclusion body myositis (sIBM) and polymyositis (PM).² There is evidence that IM can be further divided into immune-mediated necrotising myopathies (IMNM) and IM overlapping with other connective tissue diseases, especially antisynthetase syndrome (ASS) and systemic sclerosis (SSc).^{3–5} Identification of these different conditions is fundamental since each of these distinct disorders requires different management.

Distribution of muscle weakness is an important clinical feature that differentiates IM subgroups. The preferential involvement of the quadriceps and the finger flexors is the hallmark of sIBM.⁶ It has recently been reported that muscle weakness is also differentially distributed among muscles in the other IM subgroups. For instance, muscle weakness is more pronounced in the lower limbs in patients with IMNM while it is more pronounced in the upper limbs in patients with overlap IM and anti-PM/Scl antibodies.^{3,5}

Dropped head or bent spine (also referred to as ‘campocormia’) syndrome (DH/BS) is defined as an involuntary flexion of the neck or trunk, respectively, when standing, and resolving in recumbent position.⁷ IM has been found in about 15%–17% of patients with myopathic DH/BS.^{7–9} No studies have compared IM patients

with and without DH/BS. Thus, the significance of this peculiar distribution of muscle weakness is currently unknown in this setting.

In the present study, we conducted an international case–control study of IM patients with or without DH/BS.

METHODS

Study design

An international multicentre retrospective case–control study was performed: all practitioners registered on MyositEst (a network for IM in Eastern France), the Club Rhumatisme et Inflammation (a national network for rare autoimmune diseases in France), the French myositis network, the American and European Network of Antisynthetase Syndrome collaborative group and the Canadian Inflammatory Myopathy Study Group were contacted (totalling \approx 2000 physicians). These physicians were reached by electronic letters and invited to report patients suffering from IM with axial muscle impairment responsible for a DH/BS (DH/BS-IM patients). For each DH/BS-IM patient reported, physicians were asked to randomly select two IM patients without DH/BS to be included and reported as controls (control-IM patients).

Patients

Patients were included if diagnosed with IM according to the 2017 EULAR/ACR criteria for IM.² Patients with DH/BS and without other causes than IM were included as case patients (DH/BS-IM patients). Other causes of DH/BS, such as extrapyramidal syndrome, myasthenic syndrome, motor neuron disorder and a history of radiotherapy involving the paravertebral area⁷ were exclusion

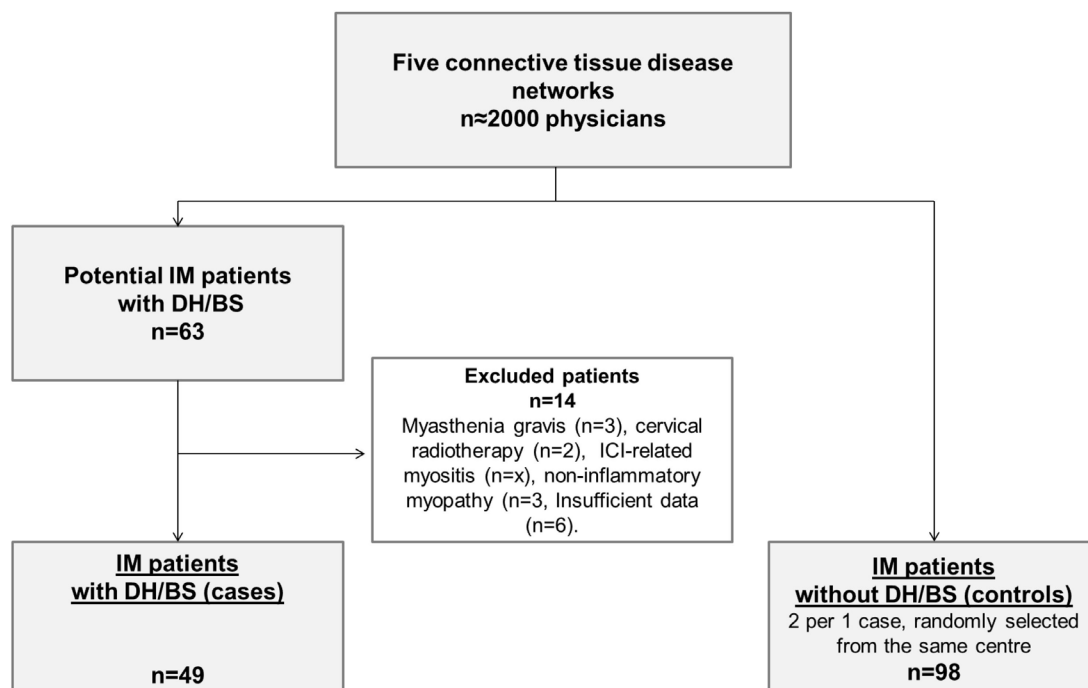


Figure 1 Flowchart of the study. DH/BS, dropped head or bent spine; IM, inflammatory myopathies.



Figure 2 Dropped head/bent spine resolving in recumbent position (E) in a patient with dermatomyositis (A) and scleromyositis (B–E).

criteria. IM patients without DH/BS at the IM diagnosis and during follow-up were included as controls (control-IM patients).

Data assessment and definitions

All data were collected using a standardised form, completed by the main practitioner in charge of the patient. All the recorded variables were defined.

- ▶ Dysphagia was defined as pharyngeal and/or oesophageal signs when eating and/or drinking (eg, difficulty swallowing solid and/or liquids, food sticking in throat, coughing while eating).
- ▶ Arthralgia was defined by inflammatory joint pain with or without arthritis.
- ▶ Pulmonary involvement was defined by interstitial lung disease on high resolution CT scan of the chest.¹⁰
- ▶ Echocardiography was used to screen for pulmonary hypertension.¹⁰
- ▶ Renal crisis was defined as decrease in renal function and (1) new onset of blood pressure >150/85 mm Hg¹¹ or (2) when normal blood pressure (normotensive renal crisis) either microangiopathic haemolytic anaemia or consistent findings on kidney biopsy.¹²
- ▶ Cutaneous involvement was diagnosed and categorised as skin thickening, puffy fingers, telangiectasia, DM rash and/or mechanic's hand ascertained by experienced physicians.
- ▶ Abnormal nailfold capillaroscopy corresponded to enlarged capillaries and/or capillary loss with or without pericapillary haemorrhages at the nailfold.¹⁰
- ▶ Improvement of the myopathy was defined as a $\geq 15\%$ improvement in strength and a $\geq 30\%$ decrease in creatine kinase level according to International Myositis Assessment and Clinical Studies Group criteria.¹³
- ▶ IM autoantibodies identification was performed according to the local protocol of each centre. At the time of the study, no guideline was available for

the set of autoantibodies to test in myositis patients. The set of autoantibodies tested in each patient was chosen by the physicians depending on the clinical phenotypes.¹⁴ All participants were expert in the field. Immunodot was used in all the centres for testing myositis-specific and associated autoantibodies (Euro-immun, D-tek). Luminex technology was used to test antisignal recognition particle and anti-3-hydroxy-3-methylglutaryl-CoA reductase autoantibodies only in a centre.

IM patients were first classified according to 2017 EULAR/ACR criteria. Patients were further classified as follows: IMNM and DM were diagnosed using ENMC criteria,^{15 16} ASS was diagnosed using Connors *et al's* criteria,¹⁷ SSc overlapping with IM was diagnosed using the 2013 ACR/EULAR criteria for SSc,¹⁰ IBM was diagnosed using Lloyd *et al's* criteria.⁶

Statistical analysis

Data statistical analyses were performed using JMP software (V.7.0). Categorical variables were compared between groups using Fisher's exact test or χ^2 test. Quantitative variables were compared using t-test (normal distribution) or Mann-Whitney test (non-normal distribution). The normality of the distributions was verified with the Shapiro-Wilk test. Parameters independently associated with DH/BS were determined by multivariate analysis (logistic regression). To this aim, features displaying an association with DH/BS with a $p < 0.05$ in the univariate analysis were included in a multivariable logistic regression analysis. The Kaplan-Meier method was used to produce survival curves, compared with the log-rank test. The interdependence of the parameters associated with survival was assessed using the Cox (proportional hazards) model.

RESULTS

The flowchart is shown in [figure 1](#). Sixty-three DH/BS patients were reported, excluding 14 patients because of myasthenia gravis (n=3), a history of cervical radiotherapy (n=2), immune checkpoint inhibitor-related myositis (n=1), non-inflammatory myopathy (n=3) or insufficient data to confirm IM (n=5). Thus, 49 DH/BS-IM patients (DH: n=28; BS: n=21) and 98 control-IM (two per one case, randomly selected from the same centre) were finally included ([figure 2](#)). Comparison of the DH/BS-IM patients with the control-IM patients is shown in [table 1](#).

DH/BS is associated with older age and delayed diagnosis of IM

DH/BS-IM patients were 12 years older at the IM diagnosis (65.0 years (55.0–74.2) vs 53.0 (42.7–63.0), $p < 0.0001$). In addition, the delay before IM diagnosis (interval between first muscular signs reported and diagnosis of IM) was twice as long in the DH/BS group (6 months (IQR: 3–11) vs 3 months (IQR: 1–9), $p = 0.009$). In both groups, the

Table 1 Characteristics of dropped head/bent spine-IM patients and control-IM patients

	DH/BS-IM patients N=49	Control-IM patients N=98	P value univariate	P value multivariate	Missing data N
Demographic data					
F/M sex ratio	2.5	2.6	0.90		0
Age at IM diagnosis, years (IQR)	65.0 (55.0–74.2)	53.0 (42.7–63.0)	<0.0001	0.03	0
Delay to IM diagnosis, months (IQR)	6 (3–11)	3 (1–9)	0.009	0.36	0
Follow-up, months (IQR)s	42.7 (17.9–83.7)	46.8 (18.4–90.33)	0.57		6
Muscle and constitutional symptoms					
Dropped head/camptocormia, n/n	28/21	0/0	–		–
Weakness of the limb, n (%)	49 (100)	95 (96.9)	0.55		0
Prevailing in upper limbs, n (%)	21 (42.9)	15 (15.3)	0.003	0.0006	0
Prevailing in lower limbs, n (%)	12 (24.5)	28 (28.6)	0.60		0
Equally affecting upper and lower limbs, n (%)	16 (32.7)	52 (53.6)	0.02		0
Muscle atrophy	32 (65.3)	34 (34.7)	0.0004	0.02	0
CK levels, UI/L (IQR)	1700 (606–4116)	1750 (619–3500)	0.90		3
Falls, n (%)	7 (14.3)	6 (6.12)	0.10		0
Loss of walking ability, n (%)	12 (24.5)	5 (5.1)	0.0005	0.04	0
Dysphagia, n (%)	28 (57.1)	25 (25.5)	0.0001	0.004	0
Weight loss, n (%), Kg	30 (61.2)	23 (23.5)	<0.0001		0
Mean weight loss(95% CI)	–9.5 (5.3 to 12)	–7.5 (4.3 to 10)	0.43		107
Systemic involvements					
Raynaud's phenomenon, n (%)	25 (51.0)	30 (30.6)	0.02		0
Abnormal nailfold capillaroscopy, n (%)	20/31 (64.5)	23/60 (38.3)	0.02		56
Digital ulcers/pitting scars, n (%)	6 (12.2)	5 (5.1)	0.2		0
Telangiectasia, n (%)	19 (38.8)	7 (7.1)	<0.0001		0
Sclerodactyly, n (%)	18 (36.7)	6 (6.1)	<0.0001		0
Puffy fingers, n (%)	11 (22.4)	3 (3.1)	0.0004		0
Scleroderma, n (%)	6 (12.2)	2 (2.0)	0.02		0
Calcinosis, n (%)	6 (12.2)	5 (5.1)	0.2		0
Dermatomyositis rash, n (%)	11 (22.4)	45 (45.9)	0.005		0
Mechanic's hands, n (%)	4 (8.2)	18 (18.4)	0.1		0
Lupus rash	2 (4.1)	0 (0.0)	0.1		0
Pericarditis, n (%)	9 (18.4)	2 (2.0)	0.0009		0
Myocarditis, n (%)	3 (6.1)	3 (3.1)	0.4		0
Pulmonary hypertension, n (%)	2 (4.1)	3 (3.1)	1.0		0
Interstitial lung disease, n (%)	18 (36.7)	30 (30.6)	0.5		0
Pleuresia, n (%)	3 (6.1)	2 (2.0)	0.3		0
Arthralgia and/or arthritis, n (%)	15 (30.6)	38 (38.8)	0.3		0
Fever, n (%)	2 (4.1)	16 (16.3)	0.03		0
Death, n (%)	10 (20.4)	9 (9.2)	0.06		0
Scleroderma renal crisis, n (%)	2 (4.0)	0 (0)	0.049		0
Cancer within 3 years of IM diagnosis, n (%)	8 (16.3)	8 (8.2)	0.13		0
Autoantibodies*					
Associated with SSc, n	15	13			
Anti-PM/Scl, n (%)†	10/35 (28.6)	5/49 (10.2)	0.04		63
Other SSc antibodies, n (%)†	8	7			0
Associated with ASS, n (%)	3	23			
Anti-Jo1, n (%)	2/48 (4.2)	18/95 (19.0)	0.02		4
Other ASS antibodies n (%)‡	1	6			4

Continued

Table 1 Continued

	DH/BS-IM patients N=49	Control-IM patients N=98	P value univariate	P value multivariate	Missing data N
Associated with DM, n (%)	8	18			
Anti-Mi2, n (%)	4/32 (12.5)	11/58 (19.0)	0.56		57
Other DM antibodies, n (%)§	5	7			39
Associated with IMNM, n (%)	5	14			
Anti-SRP, n (%)	4/25 (16.0)	4/52 (9.6)	0.43		70
Anti-HMGCR, n (%)	1/17 (5.9)	10/37 (27.0)	0.14		93
Classification					
ACR/EULAR 2017, PM/DM/IBM, n (%)	34 (69.4)/11 (22.4)/4 (8.2)	49 (50.0)/45 (45.9)/4 (4.1)	0.02		
Scleromyositis, n (%)	20 (40.8)	5 (5.1)	<0.0001	<0.0001	
DM, n (%)	7 (14.3)	39 (39.8)	0.002		
IMNM, n (%)	6 (12.2)	17 (17.4)	0.6		
IBM, n (%)	4 (8.2)	4 (4.1)	0.5		
ASS, n (%)	3 (6.1)	23 (23.5)	0.01		
Treatments and outcomes					
Number of immunomodulatory drugs¶, n (IQR)	3 (2–4)	2.5 (2–3)	0.23		0
Corticosteroids, n (%)	47 (97.9)	94 (95.9)	0.9		1
Corticosteroids maximal dose (mg/kg/day of prednisone equivalents, mean±SD)	0.9 (±0.3)	0.9 (±0.3)	0.6		11
Intravenous immunoglobulins, n (%)	32 (65.3)	34 (34.7)	0.0004		0
Biologics**	11 (22.5)	13 (13.3)	0.16		0
Dropped head/bent spine improvement	30 (61.2)	/	/		0
IMACS improvement	34 (69.4)	84 (85.7)	0.02		0

The p-value for the statistical significant comparisons between DH/BS-IM patients and Control-IM patients have been marked in bold values.

*The set of autoantibodies tested in each patient was chosen by the physicians depending on the clinical phenotypes and the antinuclear antibodies immunofluorescence pattern.

†Other autoantibodies associated with SSc were anti-Ku (4/28 vs 1/41); anti-U1-RNP (2/38 vs 6/7), anti-centromere (0/26 vs 0/39) and anti-RNAPol3 (1/17 vs 1/25).
‡Other autoantibodies associated ASS antibodies: anti-PL7 (0/34 vs 2/59), anti-PL12 (0/34 vs 1/58), anti-OJ (0/25 vs 0/35), anti-EJ (1/28 vs 3/41).

§Other autoantibodies associated DM antibodies were anti-TIF1γ (3/27 vs 4/44), anti-MDA5 (1/26 vs 1/41), anti-NXP2 (1/22 vs 1/35), anti-SAE (0/20 vs 1/29).

¶Immunomodulatory drugs included corticosteroids (n=47 (95.9%) vs n=93 (94.9%), p=1.0), methotrexate (n=25 (51.0%) vs n=48 (49.0%), p=0.8), azathioprine (n=11 (22.5%) vs n=30 (30.6%), p=0.3), mycophenolate mofetil (n=5 (10.2%) vs n=10 (10.2%), p=1.0), hydroxychloroquine (n=5 (10.2%) vs n=12 (12.2%), p=0.8), cyclophosphamide (n=1 (2.0%) vs n=9 (9.2%), p=0.2), cyclosporine (n=1 (2.0%) vs n=6 (6.1%), p=0.4), tacrolimus (n=1 (2.0%) vs n=2 (2.0%) p=1.0), sirolimus (n=1 (2.0%) vs n=0 (0.0%), p=0.3), intravenous immunoglobulins and biologics.

**Biologics included rituximab (n=11 (22.5%) vs n=0 (0.0%), p=0.2), etanercept (n=0 (0%) vs n=2 (2.0%), p=0.6), infliximab (n=0 (0.0%) vs n=1 (1.0%), p=1.0), abatacept (n=1 (2.0%) vs n=0 (0%), p=0.3).

ACR, American College of Rheumatology; ASS, antisynthetase syndrome; CK, creatine kinase; DM, dermatomyositis; EULAR, European Alliance of Associations for Rheumatology; HMGCR, 3-hydroxy-3-methylglutaryl-CoA reductase; IBM, inclusion body myositis; IMACS, International Myositis Assessment and Clinical Studies Group; IMNM, immune mediated necrotizing myopathy; SRP, signal recognition particle.

female/male ratio was about 2.5 and median follow-up was more than 3 years.

DH/BS is associated with severe myopathy

All DH/BS-IM patients had weakness of the limbs. Hallmarks of the myopathy in the DH/BS-IM patients were weakness prevailing in the upper limbs as compared with the lower limbs (42.9% vs 15.3%, p=0.0003), dysphagia (57.1% vs 25.5%, p=0.0001), muscle atrophy (65.3% vs 34.7% p=0.0004) and loss of the ability to walk (24.5% vs 5.1%, p=0.0005). Weight loss was reported in the majority of the DH/BS-IM patients (61.2% vs 23.5% in the control-IM group, p<0.0001) and reached nearly 10 kg (−9.5 kg (95% CI −5.3 to −12)). This pattern of muscle weakness and its severity were associated with DH/BS independently of other factors, especially age (p<0.05). Consistently

with the severe muscle involvement, intravenous immunoglobulins¹⁸ were used in the majority of the DH/BS-IM patients (65.3% vs 34.7%, p=0.0004). Yet, improvement of the myopathy was less frequent than in the control group (69.4% vs 85.7%, p=0.02), although DH/BS had improved (as judged by the patient and the clinician) in 61.2% of the patients at the last follow-up.

DH/BS is frequently associated with SSc overlapping with IM (scleromyositis)

Raynaud's phenomenon was more often featured in DH/BS-IM patients (51.0% vs 30.6%, p=0.02), as well as abnormal nailfold capillaroscopy (64.5% vs 38.3%, p=0.02), telangiectasia (38.8% vs 7.1%, p<0.0001), sclerodactyly (36.7% vs 6.1%, p<0.0001), puffy fingers (22.5% vs 3.1%, p=0.0004), scleroderma

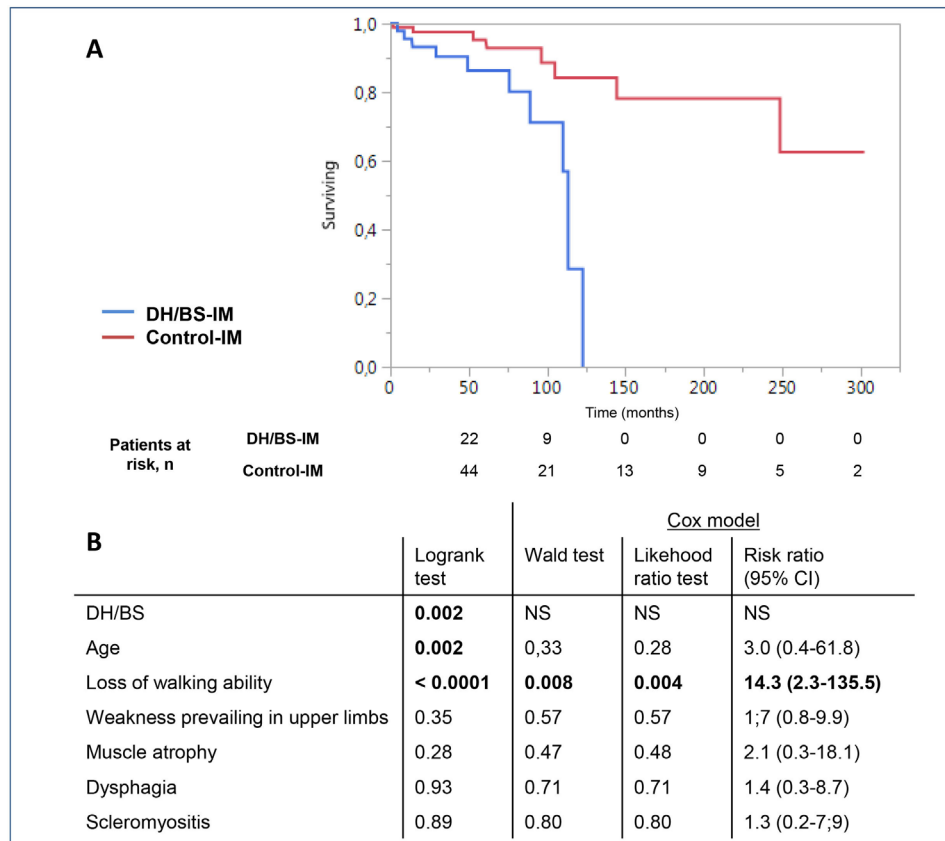


Figure 3 Survival of inflammatory myopathies patients with and without dropped head/bent spine (A) and its link (univariate and multivariate) with the six features independently associated with DH/BS identified in table 1 (B). DH/BS, dropped head or bent spine syndrome; IM, inflammatory myopathies.

(12.2% vs 2.0%, $p=0.02$), digital ulcers and/or pitting scars (12.2% vs 5.1%, $p=0.2$). In addition, other frequent systemic manifestations of SSc (but not included in ACR/EULAR 2013 criteria), such as pericarditis (18.4% vs 2.0%, $p=0.0009$), myocarditis (6.1% vs 3.1%, $p=0.4$), calcinosis (12.2%, vs 5.1%, $p=0.2$) and renal crisis (4.0% vs 0%, $p=0.049$) were all more frequent in DH/BS-IM patients. Moreover, 36.6% of DH/BS-IM had auto-antibodies associated with SSc (vs 11.1% in control-IM, $p=0.002$), the most frequently reported being anti-PM/Scl (28.6%). Finally, 40.8% of the DH/BS-IM patients fulfilled the

2013 ACR/EULAR criteria for SSc (vs only 5.1% in the control-IM group, $p<0.0001$). This association was maintained in the multivariate analysis ($p<0.0001$).

DH/BS is associated with increased mortality

Ten patients died in DH/BS group (20.4%) versus nine in the control group (9.2%). The main cause of death was cardiovascular events in the DH/BS-IM ($n=5$, 50%) versus cancer in the control group ($n=5$, 55%).

Survival analysis, as shown in figure 3A, showed a higher mortality in the DH/BS-IM patients ($p=0.002$).

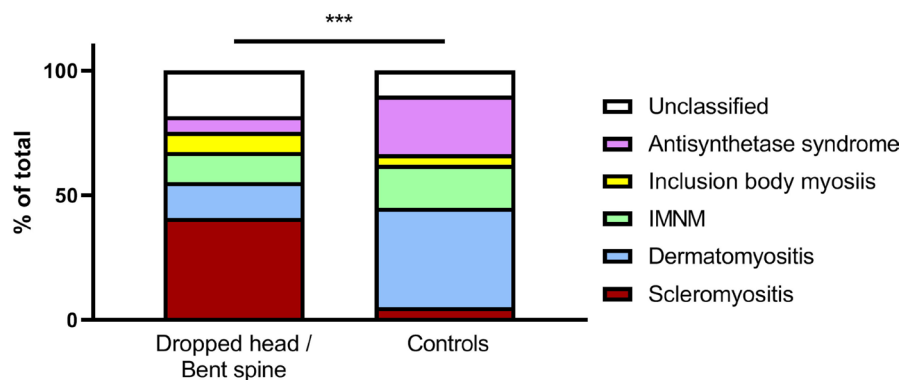


Figure 4 Inflammatory myopathies subtypes in patients with dropped head/bent spine and controls. IMNM, immune-mediated necrotising myopathies.

To further explore the link between DH/BS and mortality, we studied the survival of patients with and without the six features independently associated with DH/BS identified in [table 1](#) ([figure 3B](#)). Loss of walking ability was associated with mortality independently of the other factors in the Cox multivariate model (risk ratio 5.8 (95% CI 1.6 to 20.8)).

DISCUSSION

This is the first study to assess the significance of DH/BS in IM. This study benefited from a multicentre international recruitment from tertiary hospitals and different specialties, with a case-control design, suited to obtain an accurate overview of this peculiar muscle involvement in IM.

We show that IM patients with DH/BS have a delayed diagnosis, older age, severe atrophying muscle involvement prevailing in the upper limbs, dysphagia and systemic signs of SSc, fulfilling the ACR/EULAR 2013 criteria for this disease in barely half of the cases.

Scleromyositis is not recognised as a current classification of IM. Yet, this diagnosis has important consequences for patient management.¹⁹ Notably, myopericarditis and renal crisis were over-represented in DH/BS IM patients.

Despite high specificity, ACR/EULAR 2013 criteria for SSc have poor sensitivity for scleromyositis, notably because they do not take into account the autoantibodies most frequently associated with this disease.²⁰ In this regard, four of the nine DH/BS IM patients with unclassified IM ([figure 4](#)) had scleromyositis according to the clinician's opinion (3/9 with anti-Ku antibodies) consistently with a high (≥ 7) yet insufficient (< 9) ACR/EULAR 2013 score for SSc (in the absence of anti-Scl-70, anti-centromere and anti-RNA polymerase III). This points to the need for scleromyositis criteria and indicates that DH/BS might be a sign of this disease.

IM patients with DH/BS had loss of walking ability contributing to lower survival independently of older age. Mortality in this group was mainly due to cardiovascular events, as opposed to cancer in the control group. Low muscle mass and strength have been shown to be independently associated with increased all-cause mortality in different settings under the term 'sarcopenia'.²¹ Myopericarditis and aggressive treatment, more frequent in DH/BS patients, might also have played a role in this result. This highlights the severity of myopathy as a prognosis factor in IM and indicates that DH/BS might be a marker of this severity.

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Correction: *In inflammatory myopathies, dropped head/bent spine syndrome is associated with scleromyositis: an international case-control study*

Pijnenburg L, Giannini M, Bouchard-Marmen M, *et al.* In inflammatory myopathies, dropped head/bent spine syndrome is associated with scleromyositis: an international case-control study. *RMD Open* 2023;9:e003081. doi: 10.1136/rmdopen-2023-003081

The caption for figure 2 has been changed to “Dropped head/bent spine resolving in recumbent position (E) in 3 patients scleromyositis (A–E)”.

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