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ORIGINAL ARTICLE

A diagnostic study in patients with sciatica establishing the importance of localization of worsening of pain during coughing, sneezing and straining to assess nerve root compression on MRI

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Abstract
Purpose To test whether the localization of worsening of pain during coughing, sneezing and straining matters in the assessment of lumbosacral nerve root compression or disc herniation on MRI.
Methods Recently the diagnostic accuracy of history items to assess disc herniation or nerve root compression on magnetic resonance imaging (MRI) was investigated. A total of 395 adult patients with severe sciatica of 6–12 weeks duration were included in this study. The question regarding the influence of coughing, sneezing and straining on the intensity of pain could be answered on a 4 point scale: no worsening of pain, worsening of back pain, worsening of leg pain, worsening of back and leg pain. Diagnostic odds ratio's (DORs) were calculated for the various dichotomization options.
Results The DOR changed into significant values when the answer option was more narrowed to worsening of leg pain. The highest DOR was observed for the answer option 'worsening of leg pain' with a DOR of 2.28 (95 % CI 1.28–4.04) for the presence of nerve root compression and a DOR of 2.50 (95 % CI 1.27–4.90) for the presence of a herniated disc on MRI.
Conclusions Worsening of leg pain during coughing, sneezing or straining has a significant diagnostic value for the presence of nerve root compression and disc herniation on MRI in patients with sciatica. This study also highlights the importance of the formulation of answer options in history taking.

Keywords Sciatica · Diagnosis · Medical history taking · Specificity · Pain · Intervertebral disc displacement

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Introduction

The diagnosis of sciatica is based on history taking and physical examination. A recent Cochrane review showed poor diagnostic performance of most physical tests when used in isolation to identify lumbar disc herniation [1]. Recently the diagnostic accuracy of history items to assess the presence of disc herniation or nerve root compression on magnetic resonance imaging (MRI) in 395 patients with severe sciatica was investigated by our research group [2]. 'Male gender', 'pain worse in the leg than in back' and 'a non-sudden-onset' were significantly associated with the presence of nerve root compression on MRI and 'body mass index <30', 'a non-sudden onset', and 'sensory loss'

significantly contributed to the diagnosis of a herniated disc on MRI [2]. The history item 'more pain on coughing, sneezing and straining' did not show a significant contribution. Although just a few trials investigated the diagnostic accuracy of history items, two previous studies did report a significant diagnostic value for this history item [3, 4].

In the study described above, some history items did not have a yes/no answer option, but a 3- or 4-point answer option which was dichotomized in the analysis. The question on worsening of pain on coughing, sneezing or straining had a 4-point answer option: no worsening of pain, worsening of back pain, worsening of leg pain, worsening of back and leg pain. This answer option was initially dichotomized into 'no worsening of pain' versus 'worsening of pain' regardless of the location of pain (back or leg). Post hoc the investigators of the trial wondered if the best dichotomization option was used. In theory, coughing, sneezing or straining increases pressure which results in more irritation or mechanical compression of the nerve root giving more radiating pain in the leg but not in the back. The aim of the present study therefore was to assess whether the diagnostic accuracy of this history item depends on the dichotomization choice of the answer options.

Methods

Design

This study is a post hoc analysis of a recently published cross-sectional diagnostic study on the diagnostic accuracy of history items in patients with sciatica [2]. This cross-sectional study consisted of the patients screened for eligibility, including an MRI, for a randomized controlled trial comparing early surgery and prolonged conservative care for severe sciatica [5]. Details on the methods are described in the publications of the randomized controlled trial and the cross-sectional diagnostic study [2, 5, 6].

Study population

Eligible patients were 18–65 years of age and were diagnosed with severe sciatica that had lasted for 6–12 weeks.

Baseline measures

History was taken according to a standardized protocol by six trained research nurses. Worsening of pain on coughing, sneezing or straining could be answered with

(A) 'No worsening of pain'
(B) 'Worsening of back pain'
(C) 'Worsening of leg pain'
(D) 'Worsening of back and leg pain'

In the original diagnostic study we dichotomized this answer option into "B, C, D (worsening of leg and/or back pain)" versus "A (no worsening of pain)". For the present study we also dichotomized this 4-point answer option into "C and D [Worsening of leg pain (with or without back pain)]" versus "A and B", and "C (sole worsening of leg pain)" versus "A, B, D".

Reference tests

The presence of lumbosacral nerve root compression and the presence of a herniated disc on MRI were independently assessed by two radiologists and one neurosurgeon

Table 1 Characteristics of the baseline and outcome measures (total $n = 395$)

Age in years	42.8 ± 10.0
Male sex	248 (63)
Duration of leg pain in weeks	7.0 ± 2.3
Score on the visual-analogue scale of pain in the leg[a]	63.0 ± 22.1
Days between history taking and MRI	7.2 ± 9.0
Coughing, sneezing or straining: 'no worsening of pain'	115 (30)
Coughing, sneezing or straining: 'worsening of back pain'	72 (19)
Coughing, sneezing or straining: 'worsening of leg pain'	141 (36)
Coughing, sneezing or straining: 'worsening of back and leg pain'	60 (16)
Assessed as having nerve root compression on MRI	310 (80)
Assessed as having disc herniation on MRI	331 (85)

Values are n (%) or mean ± SD

MRI magnetic resonance imaging

[a] The intensity of pain was measured by a horizontal 100-mm visual analog scale, with 0 representing no pain and 100 the worst pain ever experienced

blinded to any clinical information. The majority opinion was used in the statistical analysis [7].

Statistical analysis

Diagnostic odds ratio's (DORs) were calculated for the various dichotomization options. Additionally, sensitivity, specificity, and corresponding 95 % confidence intervals (CIs) were calculated [2].

Results

In total 395 patients were included between November 2002 and February 2005. Both history taking and MRI scans were available for 385 patients [2]. Of the included patients, 25 (6 %) already had undergone MRI before history taking (blinding for the results of MRI was not warranted for these patients) [2]. Table 1 shows the baseline characteristics and outcome measures. Only two patients had nerve root compression not caused by disc herniation on MRI.

Variations in the answer options of the history item on coughing, sneezing and straining did change the perceived diagnostic value (Table 2). The DOR changed into significant values when the answer option was more narrowed to worsening of leg pain only. As expected, the sensitivity decreased and the specificity increased. The highest DOR was observed for the answer option 'sole worsening of leg pain', with a DOR of 2.28 (95 % Confidence Interval [CI] 1.28–4.04) for the presence of nerve root compression and a DOR of 2.50 (95 % CI 1.27–4.90) for the presence of a herniated disc on MRI.

Table 3 shows the frequencies of answers given for subgroups of patients based on MRI findings.

Discussion

The current post hoc analysis shows that variations in dichotomizing answer options to the question on coughing, sneezing and straining importantly influenced its sensitivity, specificity and diagnostic accuracy. This result highlights the importance of the formulation of answer options in history taking. Worsening of leg pain on coughing, sneezing or straining appeared to have a significant diagnostic value for the presence of nerve root compression and disc herniation on MRI in patients with severe sciatica.

In addition to the calculated diagnostic odds ratios, the frequencies of the answer options for three subgroups based on MRI findings were calculated. The almost doubled percentage of reported worsening of back pain and the almost halved percentage of reported worsening of leg pain

Table 2 Diagnostic value of the history item on coughing, sneezing or straining for the presence of lumbosacral nerve root compression and/or disc herniation on MRI in patients with sciatica

Characteristics	Nerve root compression						Herniated disc					
	Number (total MRI) (%)	MRI+ = TP (total MRI+)	MRI− = FP (total MRI−)	Sensitivity (95 % CI)	Specificity (95 % CI)	OR (95 % CI)	MRI+ = TP (total MRI+)	MRI− = FP (total MRI−)	Sensitivity (95 % CI)	Specificity (95 % CI)	OR (95 % CI)
Worsening of leg and/or back pain	272 (385) 71 %	218 (306)	54 (79)	0.71 (0.66–0.76)	0.32 (0.22–0.43)	1.15 (0.67–1.96)	232 (327)	40 (58)	0.71 (0.66–0.76)	0.31 (0.20–0.45)	1.10 (0.60–2.01)
Worsening of leg pain (with or without back pain)	201 (385) 52 %	170 (306)	31 (79)	0.56 (0.50–0.61)	0.61 (0.49–0.72)	**1.94 (1.17–3.21)** ***p* = 0.01**	177 (327)	24 (58)	0.54 (0.49–0.60)	0.59 (0.45–0.71)	1.67 (0.95–2.94)
Sole worsening of leg pain	141 (385) 37 %	123 (306)	18 (79)	0.40 (0.35–0.46)	0.77 (0.66–0.86)	**2.28 (1.28–4.04)** ***p* < 0.01**	129 (327)	12 (58)	0.39 (0.34–0.45)	0.79 (0.67–0.89)	**2.50 (1.27–4.90)** ***p* < 0.01**

TP true positive, *FP* false positive, *OR* odds ratio, *95 % CI* 95 % confidence interval

Bold values indicate results with $p < 0.05$

Table 3 Frequency of reported answers to the question on coughing, sneezing and straining for subgroups of patients (based on MRI findings)

	Patients without both nerve root compression and disc herniation on MRI ($n = 56$) (%)	Patients with both nerve root compression and disc herniation on MRI ($n = 304$) (%)	Patients with a herniated disc on MRI ($n = 327$)[a] (%)
No worsening of pain	17 (30.4)	87 (28.6)	95 (29.1)
Worsening of leg pain	11 (19.6)	122 (40.1)	129 (39.4)
Worsening of back pain	16 (28.6)	48 (15.8)	55 (16.8)
Worsening of leg and back pain	12 (21.4)	47 (15.5)	48 (14.7)

[a] With or without having nerve root compression on MRI

for the patients without both nerve root compression and a herniated disc, compared to the other subgroups, facilitates interpretation of the present study results and confirms the diagnostic value of the history item on coughing, sneezing and straining.

In both previous diagnostic studies in which a significant diagnostic accuracy of the present history item was found, no location specification of the pain was mentioned [3, 4]. One study mentioned 'pain worse on coughing/sneezing/straining' and the other study 'more pain on coughing, sneezing or straining'. No other studies on the diagnostic accuracy of worsening on coughing, sneezing or straining in patients with sciatica were found.

A recent diagnostic study in patients receiving surgery for symptoms of 'lumbar stenosis' found leg pain at rest in 76 % of the 38 patients with L5-S1 foraminal stenosis and 35 % of the 60 patients with L4–5 intra-spinal canal stenosis [8]. The localization of pain (in the back and/or leg) might thus be an important characteristic in patients with symptoms of lumbar stenosis too and calls for further research.

Post-hoc analysis should always be interpreted with caution; we have to bear in mind that there is the risk of multi-testing bias, giving an increased risk that a statistically significant result will arise by chance. Therefore we limited our post hoc analysis only to the history item on coughing, sneezing and straining. Another limitation is the highly selected population of secondary care patients, which may limit the generalizability.

In summary, in this study of patients with severe sciatica the choice of answer option to the question whether pain worsens on coughing, sneezing or straining importantly influenced the diagnostic accuracy of this history item in patients with sciatica. Worsening of leg pain on coughing, sneezing or straining showed a significant diagnostic value for the presence of nerve root compression and disc herniation on MRI in patients with sciatica.

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Compliance with ethical standards

Conflict of interest None of the authors has any potential conflict of interest.

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