SHORT REPORT

Pain tolerance in patients presenting to primary care and physiotherapy services with upper limb disorders

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Background: Arm pain is a common cause of incapacity for work and is often attributed to occupational activities, but in many cases the pathogenesis is unclear.

Objective: To investigate whether arm pain in the absence of identifiable underlying pathology is associated with reduced tolerance of painful sensory stimuli.

Methods: 133 incident cases of arm pain, recruited from primary care and physiotherapy services, were classified according to a validated diagnostic algorithm. Pain tolerance was measured at three sites in each arm in response to electrocutaneous stimulation. Associations with pain tolerance (the geometric mean of the six measurements at 5 Hz) were assessed by linear regression, and findings were summarised as proportional changes in pain tolerance.

Results: Pain tolerance was generally lower than in an earlier community survey. Women had a lower tolerance than men. After allowance for sex, age, use of analgesics and anatomical extent of pain, there was no indication of reduced tolerance in patients with non-specific pain relative to those with specific local pathology.

Conclusions: Pain tolerance may be generally reduced in patients presenting to medical services with arm pain, but those with non-specific pain do not seem to have lower tolerance than those with identifiable local pathology.

Arm pain is a common cause of incapacity for work, and is often attributed to occupational activities.¹ It can arise from various specific disorders of the upper limb, but often there is no identifiable underlying pathology and the exact pathogenesis is unclear. A better understanding of its origins might point to ways of improving its prevention and management in the workplace. One possibility is that “non-specific” arm pain results from altered pain perception, as a consequence of neuroplastic changes in the central or peripheral nervous system.

In support of this hypothesis, a painful response to vibratory stimulation has been demonstrated in patients with “repetitive strain injury”,² and reduced tolerance of transcutaneous electrical nerve stimulation has been reported in patients with refractory cervicobrachial pain³ and non-specific chronic neck pain.⁴

By contrast, in a community survey of upper limb disorders, we found that pain tolerance assessed by electrocutaneous stimulation was similar in subjects with non-specific arm pain to that in asymptomatic controls.⁵ This apparent discrepancy with earlier research could have arisen because we were investigating less severe disease. We therefore assessed pain tolerance in patients with incident arm pain of sufficient severity to prompt medical consultation.

METHODS

The study sample was drawn from patients participating in a longitudinal investigation of upper limb disorders presenting to primary care and physiotherapy services. Three sources of recruitment were used for the main study: primary care patients attending eight general practices in Wessex, England, with incident arm pain as the main reason for consultation during 2001–3; a consecutive series of patients who attended local physiotherapy services with new arm pain during 2002–3; and patients seen over a 6-month period during 2003 at a clinic to which patients were referred from primary care for orthopaedic assessment and triage. The upper limb was defined by means of a shaded area on a line diagram.

All subjects from the main study completed a standardised interview and physical examination, which ascertained pain at different anatomical sites in the upper limbs, and was used to diagnose various specific disorders of the elbow, wrist and hand (lateral epicondylitis, medial epicondylitis, olecranon bursitis, carpal tunnel syndrome, tenosynovitis, De Quervain’s disease of the wrist and osteoarthritis of the thumb base and distal interphalangeal joint) according to previously defined and validated criteria.^{6–8} Those with pain in the elbow, forearm, wrist or hands, who did not fulfil any pre-specified diagnostic criteria, were deemed to have non-specific pain.

After this clinical assessment, a consecutive series of patients were recruited into the investigation of pain tolerance, which was conducted on another occasion (at an average interval of 6 weeks). Pain tolerance was assessed using an alternating current stimulator known as a neurometer (Neurotron, Baltimore, Maryland, USA). This device produces a constant alternating current in steps of 0.01 mA up to a maximum of 10 mA at three stimulus frequencies (5, 250 and 2000 Hz). The current is delivered through two standard gold electrodes that are applied to clean skin with a gel to promote adequate contact.

Tests were administered by a single observer, using a standardised protocol. The subject depressed a button while the stimulus was progressively increased, and was asked in advance to release the button when the stimulus could no longer be tolerated. The threshold stimulus was then read off. If the maximum intensity of 10 mA (or 9.8 mA at 5 Hz) was reached, the machine automatically switched off the current. A set order of testing was used for all subjects (left index finger, right index finger, left forearm, right forearm, left shoulder, right shoulder). At the finger, the electrodes were placed transversely over the palmar and dorsal aspects of the distal interphalangeal joint; at the forearm, over the dorsal surface at the mid-point of a line between the olecranon and mid-wrist; and at the shoulder over the anterior acromioclavicular joint. At each of the six anatomical sites, the test was performed once at each of the three frequencies.

Statistical analysis was carried out using STATA V. 8.0. We first assessed the distribution of pain-tolerance thresholds for each individual. The ranking of subjects was similar for each test frequency, and within subjects, the distribution of

Table 1 Association of pain tolerance with diagnostic category and other patient characteristics

Patient characteristic (n)	Proportionate increase in geometric mean of the six 5 Hz measurements (95% CI)	
	Model A*	Model B*
Sex		
Female (85)	1	1
Male (48)	1.6 (1.3 to 2.0)	1.5 (1.3 to 1.9)
Age (years)		
<45 (29)	1	1
45–54 (45)	0.8 (0.6 to 1.1)	0.9 (0.7 to 1.2)
≥55 (59)	1.0 (0.8 to 1.3)	1.1 (0.8 to 1.4)
Analgesics on day of testing		
No (105)	1	1
Yes (28)	0.8 (0.6 to 1.0)	0.8 (0.6 to 1.1)
Number of painful sites		
1 (80)	1	1
2 (30)	0.8 (0.6 to 1.1)	0.8 (0.6 to 1.1)
>3 (23)	0.8 (0.6 to 1.1)	0.8 (0.6 to 1.2)
Diagnosis		
Non-specific pain in elbow/wrist/hand (47)	1	1
Specific disorder(s) of the elbow/wrist/hand, but no non-specific pain at these sites (22)	0.8 (0.6 to 1.2)	0.8 (0.6 to 1.1)
No pain in elbow/wrist/hand (64)	1.1 (0.9 to 1.4)	0.8 (0.6 to 1.1)

*All analyses were adjusted for the source from which the patient was recruited: general practice (n = 38), physiotherapy (n = 82) or triage (n = 13). In model A, effect estimates were otherwise unadjusted. Effect estimates in model B were derived from a single model and were mutually adjusted.

thresholds at a given frequency across the six anatomical sites was skewed. We therefore elected to classify individuals according to the geometric mean of their six measurements at 5 Hz. In 21 subjects who tolerated the maximum stimulus at 5 Hz at one or more anatomical sites, we took this maximum level as the threshold to enable the calculation.

We then compared pain tolerance according to sex, age, use of analgesics on the day of testing and the number of anatomical sites with pain at the baseline clinical assessment (1–6 of the right and left shoulder, elbow and wrist/hand) and diagnostic category. For this last purpose, we defined three mutually exclusive diagnostic groups:

- (1) subjects who had non-specific pain affecting at least one site in the elbow, wrist or hand (whether or not a specific disorder was also diagnosed at another of these sites);
- (2) subjects who had a specific disorder of the elbow(s), wrist(s) or hand(s) but no non-specific pain at any of these sites;
- (3) subjects who had no pain in the elbows, wrists or hands (ie, their pain was only in the shoulder(s)).

Associations were assessed by linear regression, with the logarithm of the geometric mean of the six measures of pain tolerance as the dependent variable (log transformation was performed to render the distribution of means approximately normal). Coefficients from the models were exponentiated to derive an estimate of the proportional increase in pain tolerance for each independent variable with associated 95% CI.

Approval for the study was obtained from Southampton and South West Hampshire and Salisbury local research ethics committees.

RESULTS

Of the 315 patients who were invited to undergo assessment of pain tolerance, 133 (42%) agreed (85 women and 48 men, aged 23–65 years). They included 47 with non-specific pain in the elbow/wrist/hand, 22 with specific disorders of the elbow/wrist/

hand but no non-specific pain at these sites and 64 with no elbow/wrist/hand pain. Response rates varied little by sex, age or diagnostic category. Most subjects (73%) were still in pain when tested and 28 (21%) had used analgesics on the day of testing.

The median (interquartile range) pain tolerance was 2.45 mA (1.70–3.60 mA) in women and 4.05 mA (2.95–7.10 mA) in men. These values were lower than in our earlier community survey of arm pain, particularly in men (median 5.93 mA, interquartile range 3.73 to 9.70 mA).⁵ Table 1 summarises the associations of pain tolerance with diagnostic category and other patient characteristics. Tolerance was significantly higher in men than in women, and tended to be lower in patients who were taking analgesics on the day of testing. However, there were no consistent trends in relation to age or the number of painful anatomical sites in the arms. There was no indication of unusually low tolerance in patients with non-specific pain, either before or after adjustment for these other variables.

DISCUSSION

Our findings suggest that pain tolerance may be generally lower in patients who seek medical care for arm pain, but provide no evidence that the phenomenon is unique to non-specific arm complaints. Although the diagnostic criteria that we applied have been extensively tested,^{7,8} some patients with non-specific arm pain may have been misclassified as having specific disorders. Conversely, in some cases non-specific pain may have resulted from unrecognised local pathology. Also, we cannot exclude the possibility that some patients with specific disorders of the elbow/wrist/hand also had non-specific pain at the shoulder, or at a site outside the arm (owing to previously reported overlap of diagnoses,⁹ we did not attempt to subclassify shoulder pain). Nevertheless, if reduced pain tolerance were a special factor in the pathogenesis of non-specific arm pain, we would expect to have found evidence of the phenomenon in this investigation. It remains possible that lower pain tolerance contributes importantly to the distress and disability associated with upper limb disorders in general.

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