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Predicting central sensitisation

Whiplash patients

Background

Central sensitisation is associated with chronic pain in whiplash patients. Predicting which patients will develop central sensitisation is difficult but patient expectations of recovery predict a variety of outcomes in whiplash patients.

Method

Ninety-one whiplash patients were assessed within 1 week of their collision in order to ascertain their expectations of recovery and were then re-examined 3 months later with the Brachial Plexus Provocation Test (BPPT) as a sign of central sensitisation.

Results

Adjusting for a number of predictors, patient expectation of recovery was found to predict the results of the BPPT. Subjects who expected 'to get better soon' had a BPPT angle that was 42 degrees less (ie. closer to normal or full range) than any of the subjects who had poor recovery expectations.

Discussion

Whiplash patients who expect 'never to get better' or 'don't know' have a much higher likelihood of developing at least one sign of central sensitisation 3 months after their collision.

Keywords: whiplash injuries; prognosis; neck pain



Central sensitisation has been associated with chronic pain in whiplash patients, although the extent to which it is a result or a cause of chronic pain (or both) has not been fully elucidated.¹ If prevention of central sensitisation is to be a goal of acute therapy in whiplash patients, as has been suggested,¹ it would be helpful to have predictors of central sensitisation that could be used in the primary care setting, ideally without resorting to lengthy questionnaires, so that patients most at risk could be identified early and provided with appropriate treatments.

It has been shown that the outcomes for whiplash injury can be predicted by simple, often singular questions, ie. the answer to a single question asking whiplash patients about their expectations of recovery is a predictor of rate of recovery.² In a large, population based cohort of over 6000 whiplash patients, in the acute stage, the answer to the question: 'Do you think that your injury will...?' with response options 'get better soon', 'get better slowly', 'never get better', 'don't know', is prognostic. After adjusting for the effect of sociodemographic characteristics, postcrash symptoms and pain, health status before collision, and collision related factors, those who expected to 'get better soon' recovered over three times as quickly (hazard rate ratio = 3.62, 95% confidence interval 2.55–5.13) as those who expected that they would never get better.² Findings were similar for resolution of pain related limitations and resolution of neck pain intensity.

The use of straightforward, easily applied single question approaches in the acute whiplash patient is more likely to be of value to busy primary care practitioners than more complicated measures, and may help to predict which patients are likely to do well, and which may not. Although this approach has been shown to be statistically

prognostic in population based cohorts, with questionnaire assessments used for outcome measures, it has never been tested against physical examination outcomes, nor in the general practice setting, where prognostic factors may be amplified or diminished in their effect by virtue of other factors that select for those patients who attend primary care. Thus, studies of the use of a question assessing expectation of outcome for whiplash patients in general practice are necessary.

There are many methods reported to assess central sensitisation.³ Most require specialised equipment. One method reported to be useful includes the Brachial Plexus Provocation Test (BPPT).³ This involves a physical examination manoeuvre where the measures are an angle at the elbow and pain level on a visual analogue scale. It is considered an indication of sensitisation or hyperexcitability via a lowered threshold to a mechanical (movement) stimulus. Although there is no standard single test or combination of tests that represent the gold standard for a determination of central sensitisation, the BPPT has been shown to be abnormal (compared to controls) in whiplash patients who also have other abnormal (compared to controls) test results for measures such as cold and heat sensitivity.² The test also has high reliability.^{2,4}

The purpose of this study was to determine if patient expectations in the acute phase after whiplash injury predicted the BPPT results 3 months postwhiplash injury, adjusting for age, gender, and initial whiplash disability scores.

Method

This was a cohort study of consecutive whiplash injured patients who presented within 7 days of their collision to a single walk-in primary care centre. This centre receives whiplash patients from nearly half the city's geographical region, and for this reason was chosen as a site likely to be most

representative of acute whiplash patients seen in general practice. Patients with a motor vehicle collision and suspected whiplash associated disorder (WAD) were routinely (all) referred from general practitioners at the clinic directly to the researcher who was acting as a specialist consultant within that clinic. The researcher/specialist gathered data on subjects referred over a 2 month period in 2006. The measurements were conducted at the initial consultation as part of the routine measures provided to all patients (ie. as part of usual assessment). Prospective subjects were further assessed for inclusion and exclusion criteria at the time of initial interview.

Whiplash associated disorder grade 1 or 2 patients (ie. soft tissue injury without fracture or signs of spinal cord injury) were included if:

- they were seated within the interior of a car, truck, sports/utility vehicle, or van in a collision (any of rear, frontal or side impact)
- had no loss of consciousness
- were 18 years of age or over
- presented within 7 days of their collision.

Patients were excluded if:

- they were told they had a fracture or neurological injury (ie. grade 3 or grade 4 WAD)
- they were told they had objective neurologic signs on examination (eg. loss of reflexes, sensory loss)
- they had previous whiplash injury or a recollection of prior spinal pain requiring treatment
- they had no fixed address or current contact information
- they were unable to communicate in English
- they had nontraumatic pain
- they were injured in a nonmotor vehicle event, or were admitted to hospital.

Ethical clearance was gained from the Medical Research Ethics Committee of the institution involved.

For convenience, the study was completed over a 2 month recruitment period. A total of 91 prospective subjects were assessed, and from these, 20 were excluded (18 due to previous history, 2 due to loss of consciousness). Therefore, 71 subjects formed the cohort for study.

After a standardised history and physical examination, subjects then completed a questionnaire containing a single question concerning expectation of recovery: 'Do you think

that your injury will...?' The response options were: 'get better soon', 'get better slowly', 'never get better', 'don't know'. Subjects then completed the Whiplash Disability Questionnaire (WDQ), which is a modified version of the Neck Disability Index (NDI) with 13 items designed to evaluate whiplash related disability. The WDQ has been validated and demonstrated to have excellent short and medium term reproducibility and responsiveness in a population seeking treatment for WAD.⁵⁻⁸ It is particularly useful as it includes an assessment of pain levels and psychological distress, both factors which predict recovery.⁹ The patients were prescribed a standardised treatment as appropriate with the physician blind to the WDQ and expectation questionnaires. Standard treatment included simple analgesics, home exercises, a standardised education, and referral to an exercise based program. It is not known whether subjects sought other therapies. Subjects were asked to return for a 3 month assessment even if improved or recovered, and were contacted by phone if necessary to increase compliance with the 3 month assessment. To avoid researcher bias, the researcher had no knowledge of any of the survey instruments, nor did the treating GPs.

At 3 months postinjury, subjects completed the WDQ, and as a measure of central sensitisation, the BPPT was performed while the examiner was blind to the results of the WDQ. The BPPT was performed as described elsewhere.³ In brief, the BPPT was always performed on the left side first, with the technique involving the application of gentle shoulder girdle depression, glenohumeral abduction and external rotation in the coronal plane, with wrist and finger extension and elbow extension. The range of elbow extension was measured at the subjects' pain threshold using a standard goniometer aligned along the midhumeral shaft, medial epicondyle and ulnar styloid. If the subject did not experience pain, the test was continued until the end of available range. At the completion of this test, the subjects were asked to record their pain on a 10 cm visual analogue scale (VAS).

At the time of the study all subjects were in a system of new legislation in Canada that places a cap on compensation for whiplash grade 1 and 2, of C\$4000, with a standardised diagnostic treatment protocol applied to each subject. This system has been described elsewhere.¹⁰

All subjects had filed a claim with an insurance company to receive treatment benefits.

Linear regression was conducted with the independent variables of age, gender, expectation of recovery, and initial WDQ score as predictors of BPPT angle and BPPT VAS. As the distribution of age and WDQ scores may not be normal, these continuous variables were also converted to categorical variables. For age, the clinically meaningful categories (shown to have prognostic significance) were age less than 40 years and age over 40.8 years. For WDQ, the clinically meaningful categories were scores in the low (0–40), medium (41–80) and high (81–130) range. After examining for confounding and interactions, the remaining terms were included in a final stepwise regression. For expectation, preplanned multivariate analysis of variance (MANOVA) was also conducted if expectation was found to significantly predict either BPPT angle or VAS scores. Significance was set at $p < 0.05$.

Results

Two subjects did not return to follow up and were removed from the study, thus leaving a final cohort with follow up data for 69 of 71 eligible subjects. The 69 subjects were 32 males, 37 females, mean age 37.5 ± 13 years (range 18–71). The mean WDQ score within 7 days of injury was 64 (standard deviation ± 23, range 26–114). The mean age of the two subjects that could not be reached at follow up was 34.0 ± 15 years (two females, one male), and their mean initial WDQ score was 76 (standard deviation ± 30).

The initial responses to expectation of recovery were:

- get better soon: 29/69
- get better slowly: 13/69
- never get better: 7/69
- don't know: 22/69.

At the 3 month follow up, the mean BPPT elbow extension (from 180 degrees) was 41.5 degrees (standard deviation 23.0), and the mean VAS score for the BPPT was 2.2/10 (standard deviation 1.2). These results, for the group as a whole, are in keeping with findings from other studies of whiplash cohorts.^{3,11}

Following linear regression analyses with single variables, only expectation was significant in predicting BPPT angle and VAS at 3 months. Multivariate analysis of variance revealed that

there was no significant difference in the BPPT angle between subjects who responded that their initial expectation was ‘never get better’ or ‘don’t know’. But subjects who expected ‘to get better slowly’ had a BPPT angle that was nearly 30 degrees less (ie. closer to normal or full range) than either of these two groups with poor recovery expectations. And subjects who expected ‘to get better soon’ had a BPPT angle that was 42 degrees less (ie. closer to normal or full range) than either of these two groups with poor recovery expectations. Meanwhile, there was no significant difference in the BPPT VAS score between subjects who responded that their initial expectation was ‘never get better’, ‘get better slowly’, or ‘don’t know’. Yet, subjects who expected ‘to get better soon’ had a BPPT VAS that was nearly 1.0 points less than any of the three groups with the less optimistic recovery expectations (*Table 1*).

Discussion

If central sensitisation is an important mechanism in chronic pain after whiplash injury, it is important to be able to identify those most at risk for this development. They may be targeted for other treatments, though there are no studies currently that identify what those other treatments might be. Given the constraints of primary practice, practitioners can achieve this goal by asking a single question concerning expectation of recovery. Those who expect ‘never to get better’ or ‘don’t know’ have a much higher likelihood of developing at least one sign of central sensitisation 3 months later. On the other hand, those who expect to ‘get better soon’, will have essentially a negative (normal) BPPT test, and not be labelled as having central sensitisation by this test.

While this study has limited power to rule out the possibility of age, gender, or initial WDAQ score predicting the results of the BPPT 3 months later, there is a strong association between initial expectations and recovery and the BPPT results. Only 10% of subjects would be classified as WAD 1 (normal range of motion with pain only and no local tenderness). The study groups were too small to determine if WAD classification would modify the association between expectation and BPPT findings. This study is also limited by the fact that there were no other physical examination findings, such as spine range of motion taken into consideration. Yet, spine range of motion

Table 1. Brachial Plexus Provocation Test elbow extension angle and Visual Analogue Score according to initial expectations of recovery

| Expectation after acute whiplash injury | BPPT angle (degrees ± standard deviation) | BPPT VAS (out of 10 ± standard deviation) |
|---|---|---|
| Get better soon | -22.4 ±3.6* | 1.6 ±0.3* |
| Get better slowly | -35.8 ±4.6* | 2.5 ±0.4 |
| Never get better | -65.0 ±5.5 | 3.4 ±0.4 |
| Don't know | -64.8 ±2.8 | 2.6 ±0.2 |

A greater, more negative in direction from 180 degrees, angle and greater VAS is more abnormal for this test

* Statistically significant difference from other groups

at a single assessment may not be relevant if previous range is unknown. In addition, the pretest symptom of arm pain was not recorded. However, studies have not found a difference in BPPT results between whiplash patients with or without arm pain.^{3,11} One could also have considered measuring the BPPT in the acute phase. There are no studies in whiplash patients that address early and late BPPT findings. In fact, it is not clear what the BPPT in the acute setting would signify, since central sensitisation (in the chronic stage) is indeed meant to indicate a mechanism for chronic pain in the absence of a peripheral lesion. An abnormal BPPT in the acute setting could not distinguish between an acute lesion (and its effects) and central sensitisation, and therefore would not be useful. What can be said, and this is important if one understands the BPPT as an outcome measure, is that despite the wide range of measures these patients may have started with, expectation predicts the BPPT findings at 3 months.

A problem with the BPPT is that there is as yet no normative database in the healthy population for this test. At best, we have limited samples of control groups for comparison.^{3,11} All one may find in any given study is that groups differ in terms of the BPPT results. The BPPT results from this study agree in some aspects with other cohorts.^{3,11} Studies of large populations are needed to form a normative database to make this test even more useful in clinical practice.

It is interesting that expectation of recovery can in turn predict a physical examination finding 3 months later. It is also difficult to explain, especially if central sensitisation is considered a pathological process, how it should be predictable by knowledge of a subject’s expectations of recovery. Expectation of recovery, however,

appears to also be useful in predicting other outcomes, suggesting that it is a belief which leads either to certain behaviours or is associated with other factors portending a poor outcome. What is impressive is that this single question predicts outcome equally as well as much more intensive and lengthy questionnaires that have been used to predict outcome in whiplash patients.¹²

Conclusion

In this study, expectation is adjusted for anxiety and pain levels vis-à-vis the adjustment for the WDAQ scores. That is, expectation is a predictor of outcome irrespective of initial pain levels. It is not due to the fact that the patient knows they have more pain and feels their outcome will be worse, but rather expectation of recovery is a predictor of outcome independent of pain. There are other mechanisms which must be associated with the predictor effect of expectation. It has been suggested that coping style may be one mechanism.¹³ Those who have expectations of no recovery or slow recovery are also likely to have a passive coping style which may in turn lead to behaviours that lead to slower recovery.¹⁴ Although in this study it was found that patient expectation predicts the BPPT findings at 3 months, further study is needed to determine what behaviours in whiplash patients follow from expectations.

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