PAIN® 155 (2014) 1836–1845

PAIN®

www.elsevier.com/locate/pain

Effect of pain location and duration on life function in the year after motor vehicle collision

Andrey V. Bortsov [a], Timothy F. Platts-Mills [a,b], David A. Peak [c], Jeffrey S. Jones [d], Robert A. Swor [e], Robert M. Domeier [f], David C. Lee [g], Niels K. Rathlev [h], Phyllis L. Hendry [i], Roger B. Fillingim [j], Samuel A. McLean [a,b,*]

[a] Department of Anesthesiology, University of North Carolina, Chapel Hill, NC, USA
[b] Department of Emergency Medicine, University of North Carolina, Chapel Hill, NC, USA
[c] Department of Emergency Medicine, Massachusetts General Hospital, Boston, MA, USA
[d] Department of Emergency Medicine, Spectrum Health Hospital—Butterworth Campus, Grand Rapids, MI, USA
[e] Department of Emergency Medicine, William Beaumont Hospital, Royal Oak, MI, USA
[f] Department of Emergency Medicine, St Joseph Mercy Hospital, Ann Arbor, MI, USA
[g] Department of Emergency Medicine, North Shore University Hospital, Manhasset, NY, USA
[h] Department of Emergency Medicine, Baystate Medical Center, Springfield, MA, USA
[i] Department of Emergency Medicine, College of Medicine, University of Florida and Shands Jacksonville, Jacksonville, FL, USA
[j] Department of Community Dentistry and Behavioral Science, College of Dentistry, University of Florida, Gainesville, FL, USA

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

ARTICLE INFO

Article history:
Received 20 November 2013
Received in revised form 16 June 2014
Accepted 19 June 2014

Keywords:
Motor vehicle collision
Musculoskeletal pain
Pain interference
Whiplash

ABSTRACT

Persistent musculoskeletal pain is common after motor vehicle collision (MVC) and often results in substantial disability. The objective of this study was to identify distributions of post-MVC pain that most interfere with specific life functions and that have the greatest interference with aggregate life function. Study data were obtained from a prospective longitudinal multicenter emergency department–based cohort of 948 European Americans experiencing MVC. Overall pain (0–10 numeric rating scale [NRS]), pain in each of 20 body regions (0–10 NRS), and pain interference (Brief Pain Inventory, 0–10 NRS) were assessed 6 weeks, 6 months, and 1 year after MVC. After adjustment for overall pain intensity, an axial distribution of pain caused the greatest interference with most specific life functions (R^2 = 0.15–0.28, association P values of <.001) and with overall function. Axial pain explained more than twice as much variance in pain interference as other pain distributions. However, not all patients with axial pain had neck pain. Moderate or severe low back pain was as common as neck pain at week 6 (prevalence 37% for each) and overlapped with neck pain in only 23% of patients. Further, pain across all body regions accounted for nearly twice as much of the variance in pain interference as neck pain alone (60% vs 34%). These findings suggest that studies of post-MVC pain should not focus on neck pain alone.

1. Introduction

Motor vehicle collisions (MVCs) result in 50 million injuries worldwide and almost 4 million U.S. emergency department (ED) visits each year [36,49]. In the United States, approximately 90% of individuals presenting to the ED for care after MVC are discharged to home after ED evaluation [41]. Health care expenses and productivity loss from persistent post-MVC pain cost an estimated $29 billion per year in the United States alone [16,20]. The development of effective interventions to prevent persistent pain after MVC and the advancement of understanding to guide these interventions remain important international research priorities [29,58].

Most contemporary studies of post-MVC pain focus primarily or exclusively on pain in the neck region [32,45]. Although pain location has been linked to function and psychological conditions in patients with chronic nonmalignant pain [14,18,23] and the extent of pain has been consistently linked to pain interference in different patient populations [1,6,35], little is currently known

* Corresponding author at: University of North Carolina, Medical School Wing C CB#7010, Chapel Hill, NC 27599-7010, USA. Tel.: +1 (919) 843 5931; fax: +1 (919) 966 7193.
E-mail address: smclean@aims.unc.edu (S.A. McLean).

http://dx.doi.org/10.1016/j.pain.2014.06.013
0304-3959/

regarding patterns of pain experienced by individuals after MVC. In addition, little is currently known regarding how these patterns of pain influence overall pain interference and specific functional disability and this influence evolves over time. A better understanding of the association between post-MVC pain distribution and functional outcomes has the potential to enrich our understanding of which individuals are at greatest risk for disability and of the functional challenges experienced by patients with specific locations/distributions of pain. Understanding how post-MVC pain location and distribution impact specific life functions would also be valuable to practitioners designing treatment interventions for individuals with persistent post-MVC pain and assessing the functional outcomes of these interventions. In addition, evaluating the influence of pain duration and of individual demographic characteristics on activity interference can provide us with additional information regarding how the functional toll of pain of a given severity and distribution changes over time.

We previously evaluated the prevalence of pain in individual body regions in the hours after MVC [8] and 6 weeks after MVC [33]. In these studies, we found that pain in specific body areas in the axial region (eg, neck, shoulders, back) were most commonly reported. However, patients do not experience individual body regions of pain in isolation but rather experience patterns of pain distributed across body regions. In this study, we sought to assess patterns of persistent pain across body regions that are common after MVC. Also, most importantly, we sought to assess the impact of different patterns of persistent pain on pain interference with specific life functions and with overall function. Because pain in axial regions has been associated with worse physical and mental health in the general population [11,31,52] and because movement of the neck and back are necessary to perform most life functions, we hypothesized that an axial distribution of pain after MVC would result in greater disability than other pain distributions. In addition, we also evaluated the influence of post-MVC pain duration and of individual sociodemographic factors (age, sex, and education) on pain-related functional interference.

2. Methods

2.1. Study design and participants

This multicenter ED-based observational cohort study evaluated pain and functional outcomes 6 weeks, 6 months, and 1 year after MVC. Participating centers included 8 EDs in 4 no-fault insurance states in the United States (Massachusetts, Florida, Michigan, and New York). Recruitment took place between February 2009 and October 2011. Institutional review board approval for the study was obtained at each study site, and each participant provided written informed consent. Complete information regarding study design, procedures, and methods has previously been described [39].

Eligible patients were alert, oriented, English-speaking European Americans 18 to 65 years of age who were present to one of the study site EDs for evaluation after MVC. Patients were included regardless of the location of impact to the vehicle; location of impact has been shown to not be a strong determinant of post-MVC pain distribution [4,28]. Patients with spinal fracture or dislocation; neurologic signs, including decreased/absent deep tendon reflexes or weakness; skull fracture, facial fracture, intracranial injury, or long bone fracture; and laceration with significant hemorrhage, as well as those presenting more than 24 h after injury, were excluded, as were prisoners, pregnant women, and individuals who could read English. Clinically unstable patients or patients who had potentially life-threatening injuries were also excluded.

2.2. Data collection procedures

Patients were screened and recruited by research assistants at each ED site. Baseline interviews were completed in the ED; follow-up interviews were completed via Internet self-report survey or via telephone interview 6 weeks, 6 months, and 1 year after MVC. Each research assistant conducting follow-up interviews completed a study training module followed by an interview with a standardized mock patient. Comparison of mock patient data across research assistants demonstrated an error rate of 1.3%.

2.3. Measures

Demographic information (age, sex, education, relationship/marital status) was assessed during the baseline ED interview using standardized questionnaire items. Injury scoring of each patient injury was performed using the Abbreviated Injury Scale (AIS), an anatomically based scoring system that classifies each injury according to its relative severity on a 6-point ordinal scale [3]. Pain intensity, distribution, and pain interference were assessed via telephone interview or a Web-based questionnaire. Location and intensity of pain symptoms during the past week were assessed 6 weeks, 6 months, and 1 year after MVC using the modified Regional Pain Scale [56]. Pain intensity in each region was evaluated via numeric rating scale (NRS) from 0 (no pain) to 10 (maximum possible pain). Overall pain intensity was also assessed using the 0 to 10 NRS. Widespread pain was defined according to American College of Rheumatology 1990 criteria [57].

Pain interference with life functions was assessed using the Brief Pain Inventory (BPI) [10,26]. The relationship between pain intensity and pain interference with life function (disability) using BPI subscales has been demonstrated across multiple studies [10,26,48]. BPI subscales assess interference with 7 life functions (general activity, walking ability, mood, relations with other people, sleep, and enjoyment of life) on a 0 to 10 scale, where 0 represents "does not interfere" and 10 indicates "interferes completely" [10]. Pain interference scores assessed at 6 weeks were used in statistical analyses, except for analyses evaluating the effect of time from trauma, in which pain interference scores from the respective time point were used.

2.4. Statistical analyses

Values of interference subscales were averaged to calculate a pain interference total score for each individual [10]. Reliability of this score was assessed by Cronbach's α and by evaluating correlation coefficients between this score and individual subscale scores.

Principal component analysis (PCA) was used to reduce the dimensionality of the regional pain data (obtained from the 20-item regional pain scale) and identify specific post-MVC pain distributions. The PCA method was used to extract the components. The number of components to retain was determined by applying Kaiser-Guttman criterion [59] and by visual exploration of a scree plot. A varimax (orthogonal) and oblique rotation were applied, and the results were compared for interpretability. In interpreting the rotated factor pattern, an item was determined to load on a given component if the factor loading was 0.50 of greater for that component [19]. Items were allowed to load on more than 1 component only if the anatomical location of the item suggested its contribution to more than 1 pain region. Association of the principal components with pain interference subscales and total score was performed using a general linear model. Adjustment for participant age and sex was performed by running regression models with these predictors and outputting the residuals. The strength of