http:// ijp.mums.ac.ir
Short Communication (Pages: 15919-15924)

Pain Neuroscience Education: A Pilot Trial in Pediatric Primary Headache

* Isidora R. Beach[1], Rachel M. Madhur[1], Peter M. Bingham[2]

[1] B.A., Larner College of Medicine, University of Vermont, 89 Beaumont Avenue, Burlington, VT, 05405, USA.

[2] M.D., Pediatric Neurology, University of Vermont Medical Center, 111 Colchester Avenue, Burlington, VT 05041, USA.

Abstract

Background: Pain neuroscience education (PNE) improves the functional outcomes of adults with chronic pain, and may also benefit children with chronic pain. We assessed pediatric primary headache patients' baseline understanding of PNE through interviews and standardized questionnaires, and piloted an educational intervention using a 3D brain model.

Methods: Seventeen patients, aged 12-18 with primary headaches, completed the interview, pre-intervention Concept of Pain Inventory (COPI), and an educational session. Twelve of these participants completed the post-intervention COPI. The patients completed the validated COPI at a regular clinic visit, and completed interviews focused on their concepts of and relation to their pain symptoms, used to tailor education to individual understanding. PNE included a presentation of a 3D-printed brain model (printed from a brain MRI) and a ten-minute discussion. The session concluded with a post-intervention COPI to gauge the intervention's impact on the subjects' views of primary headache.

Results: Comparison of pre- and post- intervention COPI scores revealed an average 9.5 point score increase (p=0.002). Overall low pre-intervention scores suggested a low baseline alignment with the concepts of PNE, additionally supported by the interview answers. The participants were generally interested in learning more about PNE, and were teachable as indicated by the significant COPI score increase.

Conclusions: Pediatric primary headache patients are typically not well-versed in central concepts of PNE, but interactive sessions can increase understanding. 3D brain models can be an effective vehicle for delivering PNE. These findings support further research on the efficacy of PNE in the setting of pediatric headache.

Key Words: Chronic Pain, Primary Headache, 3D model.

* Please cite this article as: Beach IR, Madhur RM, Bingham PM. Pain Neuroscience Education: A Pilot Trial in Pediatric Primary Headache. Int J Pediatr 2022; 10 (5):15919-15924. DOI: **10.22038/IJP.2022.63880.4853**

Corresponding Author:

Isidora R. Beach, B.A., Larner College of Medicine, University of Vermont, 89 Beaumont Avenue, Burlington, VT, 05405, USA. Email: Isidora.beach@med.uvm.edu

Received date: Feb.20,2022; Accepted date:May.16,2022

1- INTRODUCTION

Headaches are the most common referral to a pediatric neurology clinic, affecting up to 60% of pediatric patients worldwide (1). Primary headache (not due to a structural defect) is a leading cause of pediatric chronic pain, with quality-of-life effects equaling those of cancer or rheumatoid disease (2). Education to shift patient perspectives on chronic pain can be an effective treatment as demonstrated in the emerging area of pain neuroscience education (PNE). PNE follows the biopsychosocial approach to pain using a multi-factorial model. PNE typically includes a biological explanation of the mechanisms underlying pain processing and hypersensitivity combined with an explanation of cognitive and emotional processes influencing the pain experience. PNE encourages patients to re-evaluate the way they understand pain, offering a "common language" for improved physician-patient communication that ultimately alters the pain response (3).

PNE is supported in the adult population. One study on adults with chronic back pain receiving three sessions of PNE over a twelve-week period demonstrated moderate-to-large improvement in pain sensitivity, pressure pain thresholds, and conditioned pain modulation at one year (4). PNE is understudied in pediatrics, but evidence supports educational interventions for pediatric headache. A 2007 randomized trial assigned pediatric headache patients to receive a traditional neurological examination or an examination and an educational session on headache pain and related interventions. The patients who received education demonstrated a 60% decrease in headache-related disability at the six-month follow-up (5).

PNE must be crafted in the context of children's baseline understanding of pain. The recently validated "Concept of Pain Inventory" (COPI) offers a quantitative approach to this assessment (6). In this survey, children rate their agreement with key PNE teaching points and receive a total score reflecting their level of understanding. We used the COPI and open-ended questions to evaluate the baseline knowledge and perspectives on pain among pediatric primary headache patients. This was followed by a ten-minute PNE session incorporating a 3D brain model, after which the participants completed the COPI again.

1-1. Specific aims of the study

1. Learning the pediatric headache patients' conceptions of pain using open-ended questions and a structured (COPI) survey.

2. Conducting a pilot PNE session using a brain model based on the established teaching points (3, 6, 7).

3. Using before and after COPIs to determine effectiveness of the intervention.

2- MATERIALS AND METHODS

2-1. Study population and recruitment

This study was approved by the University Institutional Review Board. All patients of the University Child Neurology Clinic meeting the following criteria were recruited: (1) age 12-18, (2) primary headache diagnosis, (3) in-person appointment, and (4) presence of a parent or guardian (for children 12-17). Patients with a secondary cause for headache or those seen via telehealth were excluded.

2-2. Procedure

Eligible patients were enrolled at regular clinic visits after discussion with a member of the research team. The participants completed a baseline COPI, and were interviewed on their headache experience and understanding of pain. A ten-minute PNE session was then tailored to interview responses. Afterwards, the participants filled out a repeat COPI.

2-3. Intervention

Using a 3D-brain model as a visual aid, the PNE session focused on pain processing, pain sensitization, biopsychosocial factors influencing pain, and pain control. Specifically, this included education on neuronal pain signaling, the modulatory effects of stress and negative emotions, and the concept of hypersensitization using a broken alarm clock metaphor (8). The session concluded with a discussion of neuroplasticity and learning, emphasizing that the brain can be trained to feel less pain over time through education and physical activity.

2-4. Data Analysis

Total COPI scores per participant were tested for normality of distribution using the Graphpad Prism statistical software. The difference between the pre and posttest COPI scores was reported as a mean (M) and standard error (SE). A Wilcoxon signed-rank test compared these data to generate a p-value. Mean scores per answer were also calculated across all participants, using median adjustment for responses left blank (two values). Frequency of individual answer responses were manually plotted in pivot tables.

3- RESULTS

Seventeen participants enrolled (13 female, 4 male); ages ranged from 13-18 years (M=15, SD=1.5). Seventeen completed the baseline COPI and interview; twelve completed the repeat COPI.

3-1. COPI Results

Higher scores indicated greater alignment with contemporary pain science, with a maximum score of 56 (6). The average COPI score before PNE was 36 (N=17); after PNE this rose to 47 (N=12). The average difference was +9.5 points (SE=1.9), significant by the Wilcoxon signed-rank test (p=0.002).

Frequency of responses per COPI statement are shown in **Tables 1** and **2**. 'Strongly disagree/disagree,' 'unsure,' and 'agree/strongly agree' were considered as the three separate categories. On the baseline COPI, the statement with the greatest percentage of both 'strongly disagree/disagree' responses (29%) and 'unsure' responses (47%) was found in the responses to the following item: "learning about pain can help you to feel less pain." The statement with the greatest percentage of 'agree/strongly agree' responses was found in the responses to the item of "feeling stressed can make you feel more pain" (88%).

After PNE, the statement with the most agreement was "doing something you enjoy can make you feel less pain," (93%). The statement with the greatest percentage of both 'disagree/strongly disagree' (14%) and 'unsure' responses (14%) was "you can have an injury and feel no pain." The statement with the greatest increase in agreement after PNE was "learning about pain can help you to feel less pain," with an additional 64% of participants agreeing, an increase of 358%.

Average scores per item were calculated. The statement with the greatest score increase from baseline in the posttest COPI was "learning about pain can make you feel less pain," which moved from 'unsure' to 'agree' (average difference of 1.4 points). The statement least changed in the posttest COPI, as compared to the baseline, was "you can feel pain even after an injury heals," with an average difference of only 0.1 point.

3-2. Interview Answers

Several patterns were identified in the interview responses. Most participants indicated curiosity about the pain science behind headaches, specifically, "why we get them." 64% indicated either "not much" or "I don't know" when asked what doctors or other healthcare workers had previously explained to them about their headaches. 52% commented that they did not have any ideas about the causes of their headache, yet 76% answered either "yes" or "sometimes" when asked if they ever worried about the cause. Five respondents referenced a growth or brain tumor as their specific worry. The question "what is your understanding of how pain works?" garnered a wide variety of responses, a representative response being, "I don't know how to describe that, it's like asking somebody what happiness feels like!"

Table-1: Frequency of pre-PNE COPI responses

Items	Choices				
	Strongly disagree (0)	Disagree (1)	Unsure (2)	Agree (3)	strongly agree (4)
Question 1	0%	6%	6%	47%	41%
Question 2	0%	12%	41%	18%	29%
Question 3	0%	12%	18%	53%	18%
Question 4	6%	0%	24%	41%	29%
Question 5	0%	6%	35%	41%	18%
Question 6	6%	6%	35%	41%	12%
Question 7	0%	18%	18%	47%	18%
Question 8	0%	29%	47%	18%	6%
Question 9	18%	6%	18%	59%	6%
Question 10	0%	6%	29%	59%	6%
Question 11	0%	12%	29%	53%	6%
Question 12	0%	6%	24%	53%	24%
Question 13	0%	0%	29%	71%	6%
Question 14	0%	12%	29%	53%	6%

Table-2: Frequency of post-PNE COPI responses

Items	Choices				
	Strongly disagree (0)	Disagree (1)	Unsure (2)	Agree (3)	strongly agree (4)
Question 2	0%	0%	0%	36%	50%
Question 3	0%	0%	0%	43%	43%
Question 4	0%	0%	0%	43%	50%
Question 5	0%	0%	0%	50%	36%
Question 6	0%	0%	7%	36%	43%
Question 7	0%	0%	7%	50%	29%
Question 8	0%	0%	0%	50%	36%
Question 9	0%	14%	14%	43%	14%
Question 10	0%	0%	0%	36%	50%
Question 11	0%	7%	7%	57%	14%
Question 12	0%	7%	7%	50%	21%
Question 13	0%	0%	0%	29%	57%
Question 14	0%	7%	0%	50%	29%

4- DISCUSSION

Our PNE session, significantly, increased the participant alignment with modern pain science as suggested by the increased COPI scores. The original COPI study of children with various chronic pain conditions reported an inverse relationship between the COPI score and the degree of pain and functional disability at follow-up, highlighting the utility of increasing children's baseline understanding of pain neuroscience (6). Educational interventions for headache decrease headache activity in adults, and PNE is useful for other adult chronic pain conditions (4, 9-11). Though PNE for pediatric headache is understudied, related educational and psychological interventions are effective in this population (1, 12-15). Relaxation training, for example, teaches that stress is a major contributor to headache, and decreases total headache activity in pediatric tension-type headache and migraine (12). In combination with our results, this suggests PNE as a worthwhile intervention for improving functional outcomes in pediatric headache and warrants further study.

Within the COPI, the statement "learning about pain can make you feel less pain" had the greatest score increase after PNE, indicating that the participants learned a fundamental PNE concept: education itself is useful in decreasing pain. In interviews, the participants expressed desire to understand the causes and strategies to manage their headaches, the majority indicating that prior healthcare providers had not adequately explained their headaches' cause. Clearly, the patients are interested in increased headache education, which can foster collaborative physician-patient relationships, improve patient satisfaction, and eventually decrease overall healthcare utilization (10).

Our PNE session used a 3D brain model, but PNE materials could be distributed in other forms (pamphlets, books, etc.), making the intervention implementable in a variety of clinical settings. Though our study was limited by its small size, it points to the need for PNE in pediatric headaches.

5- CONCLUSIONS

This study represents the first assessment of pain neuroscience proficiency both before and after a PNE intervention in the setting of pediatric primary headache. The participants' low baseline understanding of pain science, high interest in PNE, and prior evidence of improved functional outcomes after PNE interventions support the utility of PNE in pediatric primary headache. Significant COPI score increases after PNE with a 3D model demonstrate that clinical education can improve pediatric pain neuroscience proficiency, in a simple intervention generalizable to other conditions causing pediatric chronic pain.

6- ACKNOWLEDGEMENTS

The authors would like to thank Brad Clopton, APRN, Dr. Deborah Hirtz, Dr. Gregory Holmes, the patients and staff of the University of Vermont Pediatric Neurology clinic, Maria Sckolnick, M.S., Dr. Laura Simons, and Dr. Josh Pate. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors have no conflicts of interest, including financial, to report.

7- REFERENCES

1. Faedda N, Cerutti R, Verdecchia P, Migliorini D, Arruda M, Guidetti V. Behavioral management of headache in children and adolescents. J Headache Pain 2016; 17(80).

2. Powers SW, Patton SR, Hommel KA, Hershey AD. Quality of life in childhood migraines: clinical impact and comparison to other chronic illnesses. Pediatrics 2003; 112: e1 – e5.

3. Robins H, Perron V, Heathcote LC, Simons LE. Pain Neuroscience Education: State of the Art and Application in Pediatrics. Children (Basel) 2016; 3(4): 43.

4. Samson, K. For Your Patients-Back Pain: Neuroscience Education Plus Targeted Exercise Improves Back Pain Outcomes. Neurol Today 2018; 18: 28 – 31.

5. Abram HS, Buckloh LM, Schilling LM, Wiltrout SA, Ramírez-Garnica G, Turk WR. A randomized, controlled trial of a neurological and psychoeducational group appointment model for pediatric headaches. Child Health 2007; 36(3): 249 – 265.

6. Pate JW, Simons LE, Hancock MJ, Hush JM, Noblet T, Pounder M, Pacey V. The Concept of Pain Inventory (COPI): Assessing a Child's Concept of Pain. Clin J Pain 2020; 36: 940 – 949.

7. Heathcote LC, Pate JW, Park AL, Leake HB, Moseley GL, Kronman CA, Fischer M, Timmers I, Simons LE. Pain neuroscience education on YouTube. PeerJ 2019; 7: e6603.

8. Coakley R, Schechter N. Chronic pain is like ... The clinical use of analogy and metaphor in the treatment of chronic pain in children. Pediatr Pain Lett 2013; 15: 1 – 8.

9. Harpole LH, Samsa GP, Jurgelski AE, Shipley JL, Bernstein A, Matchar DB. Headache management program improves outcome for chronic headache. J Head Face Pain 2003; 43(7): 715 – 724.

10. Blumenfeld, A, Tischio, M. Center of excellence for headache care: Group model at Kaiser Permanente. Headache 2003; 43: 431 – 440.

11. Louw A, Zimney K, Puentedura EJ, Diener I. The Efficacy of Pain Neuroscience Education on Musculoskeletal Pain: A Systematic Review of the Literature. Physiother Theory Pract 2016; 32: 332 – 355.

12. Larsson, B, Carlsson, J, Fichtel, A, Melin, L. Relaxation treatment of adolescent headache sufferers: Results from a school-based replication series. Headache 2005; 45: 692 – 704.

13. Holden, EW, Deichmann, MM, Levy, JD. Empirically supported treatments in pediatric psychology: Recurrent pediatric headache. J Pediatr Psychol 1999; 24: 91 – 109.

14. McGrath, PJ, Humphreys, P, Keene, D, Goodman, JT, Lascelles, MA, Cunningham, SJ, et al. The efficacy and efficiency of a self-administered treatment for adolescent migraine. Pain 1992; 49: 321 – 324.

15. Eccleston C, Morley S, Williams A, Yorke L, Mastroyannopoulou K. Systematic Review of Randomized Controlled Trials of Psychological Therapy for Chronic Pain in Children and Adolescents, with a Subset Meta-Analysis of Pain Relief. Pain (Amsterdam) 2002; 99: 157 – 165.