Acknowledgement: Journal Douleur et Analgésie edited by Lavoisier.
Publisher version can be see at:
https://dea.revuesonline.com/articles/lvdea/abs/2020/03/contents/contents.html

Exercise as a promising strategy to manage cluster headache pain: a case report

L'exercice comme approche alternative dans la gestion des algies vasculaires de la face: étude de cas

Titre court : Algie vasculaire de la face et exercice

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Conflict of interest: Written informed consent was obtained from the patient and was approved by the ethics committee of the CIUSSS de l'Estrie – CHUS. The authors declare no conflict of interest.

Word count: 9479 character including space

ABSTRACT

Background: Various pharmacological treatments have been used to relieve pain and reduce the duration and occurrence of cluster headache (CH) attacks, but these treatments remain partially effective for many patients. Aerobic exercises have been proposed to decrease the prevalence and severity of symptoms associated with other types of headaches, but the effectiveness of aerobic exercise for CH management has not yet been investigated.
Case presentation: This report describes the case of a 24 year-old male patient diagnosed with episodic CH (1/day; > 1h). Thirteen days after the first episode, moderate-intensity continuous aerobic exercise was performed (10-30 minutes) at the onset of CH attack. Aerobic exercise reduced both severity and duration of CH attacks.
Conclusions: This case report suggests that performing moderate-intensity aerobic exercise at the onset of a CH attack may be an interesting non-pharmacologic intervention that can be used to ease pain symptoms.

Keywords: Cluster Headache, Pain, Physical activity, Exercise
Mots clés: Algie vasculaire de la face, Douleur, Activité physique, Exercice

RÉSUMÉ

Introduction : Plusieurs traitements pharmacologiques sont utilisés pour soulager la douleur et réduire la durée et la fréquence des crises d'algie vasculaire de la face (CH), mais ces traitements demeurent partiellement efficaces pour plusieurs patients. L'exercice aérobie est actuellement proposé pour réduire la prévalence et la gravité des symptômes associés à d'autres types de céphalées, mais son efficacité concernant la gestion des CH n'a pas encore été documentée.
Représentation du cas : Cette étude décrit le cas d'un homme de 24 ans chez qui on a diagnostiqué des CH épisodique (1/jour ; > 1h). Treize jours après le premier épisode, des exercices aérobies d'intensité modérée étaient effectués (10 à 30 minutes) au début des crises. L'exercice aérobie a réduit à la fois la sévérité et la durée des crises de CH.
Conclusions : Cette étude de cas suggère que la réalisation d'exercices aérobies d'intensité modérée au début d'une crise de CH pourrait être une intervention non-pharmacologique complémentaire intéressante pour diminuer les symptômes douloureux liée à cette condition.

INTRODUCTION

Cluster headache (CH) is a rare neurological condition characterized by extremely painful unilateral headaches occurring in recurrent bouts or "clusters" (1). These bouts typically last 8 to 9 weeks, with attacks occurring up to 8 times a day and lasting between 15 and 180 minutes. This severe pain condition is extremely disabling and significantly reduces health-related quality of life. Current therapeutic options are mostly pharmacological treatments (e.g., oxygen therapy, sumatriptan, zolmitriptan, lidocaine). Surgical procedures (e.g., radiofrequency trigeminal gangliorhizolysis, microvascular decompression of the trigeminal nerve, partial or complete surgical sectioning of the trigeminal root) have been proposed in refractory cases, but their usefulness remains limited. Unfortunately, pharmacological and surgical treatments often fail to completely relieve patients suffering from CH (2), and undesirable side-effects such as visual loss, jaw deviation and anesthesia dolorosa, can sometimes arise (3).

Aerobic exercise is effective for the management of many chronic pain conditions (4). Interestingly, aerobic exercise has been shown to decrease the severity, frequency and duration of pain arising from other types of cephalalgias such as migraines, tension-type headaches and cervicogenic headaches (5). However, it must be noted that all these studies have investigated the efficacy of exercise as a prophylactic treatment, which does not provide evidence for the potential of aerobic exercise as an adjuvant therapy for headache abortion. To our knowledge, only two case studies reported a beneficial acute effect of exercise on migraines (6,7). Several mechanisms could explain the beneficial effect of exercise on headache, such as the release of neurotransmitters, including beta-endorphins, dopamine and

serotonin. However, to our knowledge, the effectiveness of aerobic exercise for CH management has not yet been investigated. In the present case study, we describe the effects of moderate-intensity continuous aerobic exercise (MICE) on the intensity and duration of CH attacks in a 24 year-old man diagnosed with CH.

CASE REPORT

The individual, a 24 year-old Caucasian man, was diagnosed with episodic CH by a general practitioner 10 days after the first symptom, based on clinical standard assessment (see **Table 1** for patient's characteristics). Cerebral magnetic resonance imaging and CT scan were also performed to eliminate other underlying causative pathology. It should be noted that this was the first time the patient experienced CH attacks. The patient experienced CH attacks for 13 days before initiating MICE. CH attacks were characterized by a right-sided unilateral supraorbital pain, associated with increased lacrimation, eye redness and facial swelling on the affected side. CH attacks lasted on average 1 hour and 26 minutes (8 attacks) and usually occurred once a day, often in the morning (between 8:00 and 10:00 am) or in the afternoon (between 6:00 and 7:00 pm).

Insert Table 1

The patient did not have any other disease and was physically active before the diagnosis, performing 5 to 6 sessions/week of resistance training and 50 minutes/week of MICE. Following the onset of CH, physical activity level did not change, but the patient's quality of

life was severely affected as revealed by the Short Form Survey-36 questionnaire (SF-36; **Supplementary table S1**).

Insert Table 2

The patient was treated with Verapamil (80 mg TID) 10 days after the first symptom. Sumatriptan (5 mg, PRN) was also administered in an attempt to acutely relieve pain during CH attacks. Unfortunately, both medications had very limited effects and did not prove to be effective for pain management. On the 13th day, MICE was started, based on the recommendations of an expert in exercise physiology who suggested, based on the literature on migraines (8), to perform moderate-intensity exercise to alleviate symptoms, and perhaps reduce the duration of each crisis. Exercise was mostly performed on a lower limb cycle ergometer, as close as possible to the beginning of each CH attack, which is characterized by a feeling of discomfort (slight pinching) on the affected side. The exercise duration varied according to the pain reduction observed by the patient and ranged from 10 to 30 min. If the CH attack occurred when the cycle ergometer was not available, the patient was instructed to walk at a fast speed or running outside for a similar amount of time. Exercise intensity varied from 3 to 5 on the Borg's rating perceived exertion scale (51-70 % of estimated maximal heart rate, assessed with a heart rate monitoring; Polar FT1™, Finland). Pain intensity was assessed with a 10 cm visual analogue scale (0= no pain; 10= worst possible pain) at the beginning and the end of every MICE session.

MICE slightly reduced pain intensity of CH attacks (from 6.1 ± 1.9 without exercise, to 4.6 ± 1.4 with MICE; n= 9 and n= 9 respectively). The length of CH attacks was also considerably decreased with MICE (from 86.3 ± 19.0 min without exercise [n= 8] to 50.0 ± 32.5 min with MICE [n= 9]). MICE was more effective when the exercise was performed at the onset of the CH attack, and when pain intensity was not severe (≤ 6/10 on analogue scale for pain). Indeed, when MICE was performed at the onset of the attack (n= 6), pain intensity (Figure 1) and length (Figure 2) of the CH attack decreased considerably compared to when MICE was performed with a delay and a greater perceived pain (pain intensity ≥ 6/10; day 16 and 17; figure 1). When MICE was delayed, no effect on duration and pain intensity was noted.

Insert Figures 1 and 2

DISCUSSION

CH is a complex condition for which management options remain only partially effective for many patients and can be associated with significant side effects. This case report suggests that aerobic exercise, performed at moderate intensity at the onset of a CH attack, could be an interesting adjuvant treatment option to reduce pain intensity and duration of CH attacks. Of importance, we observed that the beneficial effects of exercise were only perceived when the exercise was initiated promptly after the occurrence of the CH-related symptoms. These observations are in line with previous reports showing that aerobic exercise may abort migraines attacks when performed at the onset of the headache period (6).

The exact mechanism underlying the hypoalgesic effect of exercise on CH and other cephalalgias is currently unknown. Exercise has been associated with the release of several neurotransmitters, including beta-endorphins, dopamine and serotonin (9). Serotonin receptors are located in the trigeminovascular system, but also in the periaqueductal gray (PAG) (10), a brainstem region known to be directly involved in descending pain modulatory circuits (11). Increased in serotonin (5-HT) concentration following exercise has been proposed as a possible mechanism through which migraine attacks may be prevented (12). Indeed, migraines have been linked to a central neurochemical imbalance involving a low serotonergic disposition, which could promote the activation of the trigeminovascular nociceptive pathway (13). This mechanism also seems to be involved in the pathophysiology of CH (14). Taken together, these findings suggest that the activation of 5-HT receptors in the PAG, resulting from the exercise-induced increase in 5-HT levels (15), could activate descending pain-modulating pathways, which could be responsible for the analgesic effects observed following MICE.

Endogenous opioids also play an important role in the regulation of nociceptive signals by activating central and peripheral opioid receptors. Past studies have shown that patients suffering from CH have low concentrations of beta-endorphin during both the latent and active phases of CH attacks (16). Exercise, which triggers the release of beta-endorphin from the pituitary gland and the hypothalamus (17), could therefore play an important regulatory role in the management of pain in CH-related symptoms (9,17). Knowing that the exercise-induced increase of beta-endorphin is mainly driven by the increase of acidosis (18), further

investigation should evaluate the effect of high-intensity interval training, known to increase acidosis (19), on the modulation of pain during exercise.

Arterial baroreceptor activation, caused by the exercise-induced increase in blood pressure, could also stimulate brain regions involved in pain modulation. Animal models have shown that afferent inputs from baroreceptors can activate neuronal cells in specific regions of the PAG and in the nucleus tractus solitaries (NTS) (20), which could trigger descending pain inhibitory responses. Hence, the pain reduction observed during MICE could be linked to the exercise-induced cardiovascular responses (i.e., increased heart rate and blood pressure). Future studies, looking into the relationship between cardiovascular and hypoalgesic responses during exercise in individuals suffering from CH should be conducted.

The distraction provided by MICE during CH attacks might also prove beneficial. According to a survey of 1134 participants, CH patients often use distractive strategies (e.g., moving from one side or the other) to cope with their symptoms. About 50% of respondents reported engaging in self-injurious behavior during CH attacks, a strategy that could involve both distraction and counter-irritation (21). It is therefore possible that MICE might prevent, or replace these strategies, serving as a distraction or as an alternate method for activating top-down pain control systems.

Some limitations should be acknowledged. For example, pain assessment was performed at its peak during non-exercise days, and it remains unknow if the same effect would have been observed if the patient would have waited a greater time before beginning the exercise. As

aerobic exercise was used as a strategy to decrease pain intensity and crisis duration, it was performed at the beginning of each crisis. Considering that case reports contain several biases and limitations (e.g., tendency to confirm the researcher's preconceived notion, inability to confirm causation), the results of the present study should be interpreted with caution and confirmed with a larger randomized controlled trial.

CONCLUSION

This case report illustrates that performing MICE at the onset of an attack for 10 to 30 minutes (mean: 16.5 ± 6.2 minutes) could reduce the length of the CH attacks and slightly decrease pain intensity. Further studies with a larger sample size and with acute measurement of cerebral activity, endogenous opioids and blood pressure should be conducted to elucidate the promising effects of aerobic exercise in the management of CH attacks. Finally, the potential benefit of higher exercise intensity should also be considered in future intervention studies.

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Table 1. Patient Characteristics

Sex	Male
Ethnicity	Caucasian
Education level	Graduate student
Smoking status	non smoker
Drinking habits (consummation/week)	0
Other conditions	None
Age (years)	23.9
Weight (kg)	83.1
Height (cm)	175.2
BMI (kg/m^2)	27.1

BMI: body mass index; data were collected at the beginning of the CH period.

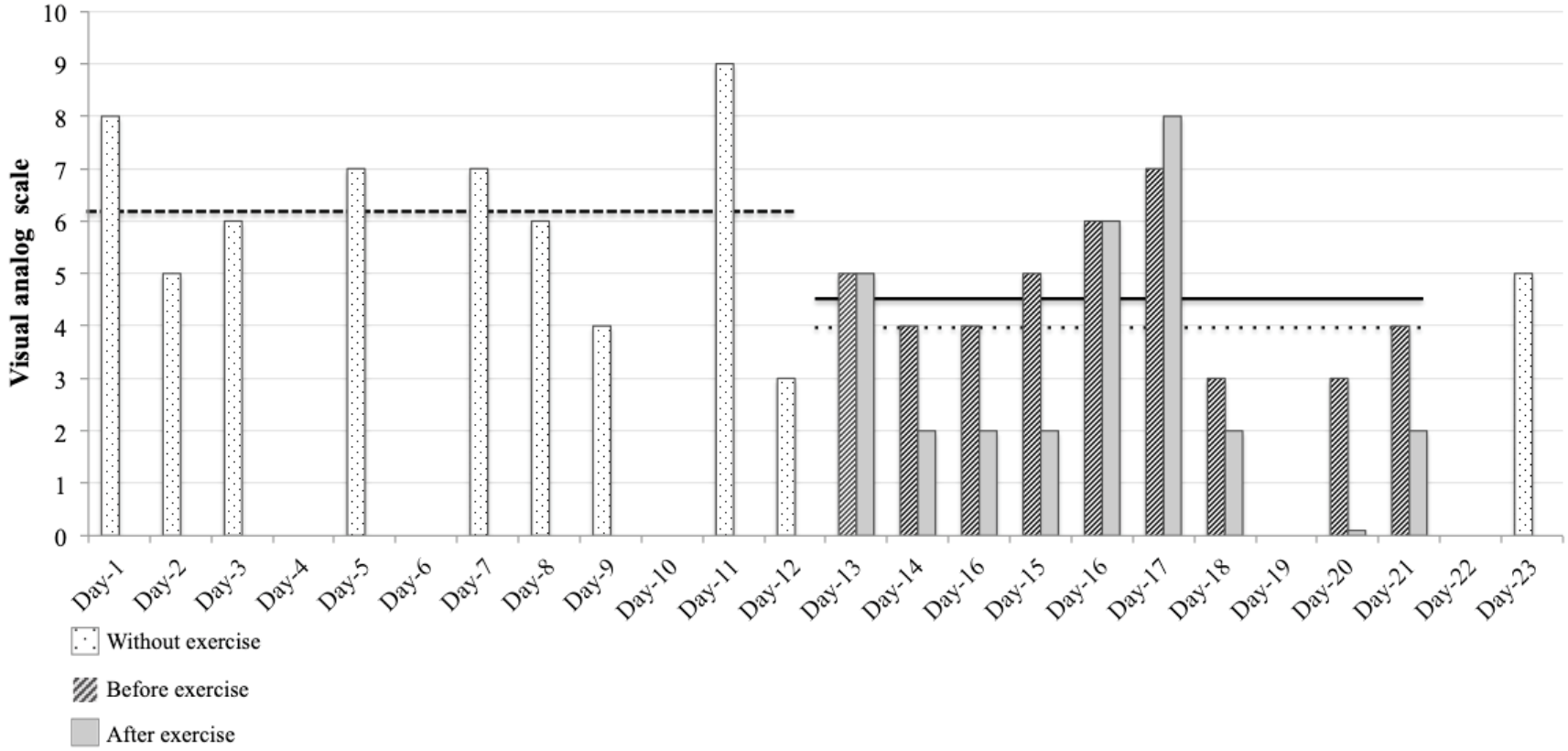

Figure 1. Patient's pain during Cluster Headache attack without and with exercise from the first cluster attack (Day 1) to the last one (Day 23)

Pain intensity was evaluated before and after each MICE session with a visual analog scale for pain (ranging from 0; no pain to 10; most intense pain), while pain during non-exercise days was evaluated at the highest point of the attack when possible. The absence of value at day 4, 6, 10, 19 and 22 means that no attack occurred during these days. Dotted line represent the mean pain without exercise (excluding day 23 due to the unknown effect of chronic exercise on the management of CH pain), flat line represent mean pain before the exercise session, while space dotted line represent mean pain after the exercise session when the exercise was performed at the onset of the first symptom (pain ≥ 6/10; day 16 and 17 pain was already at 6/10 and 7/10, respectively before performing exercise).

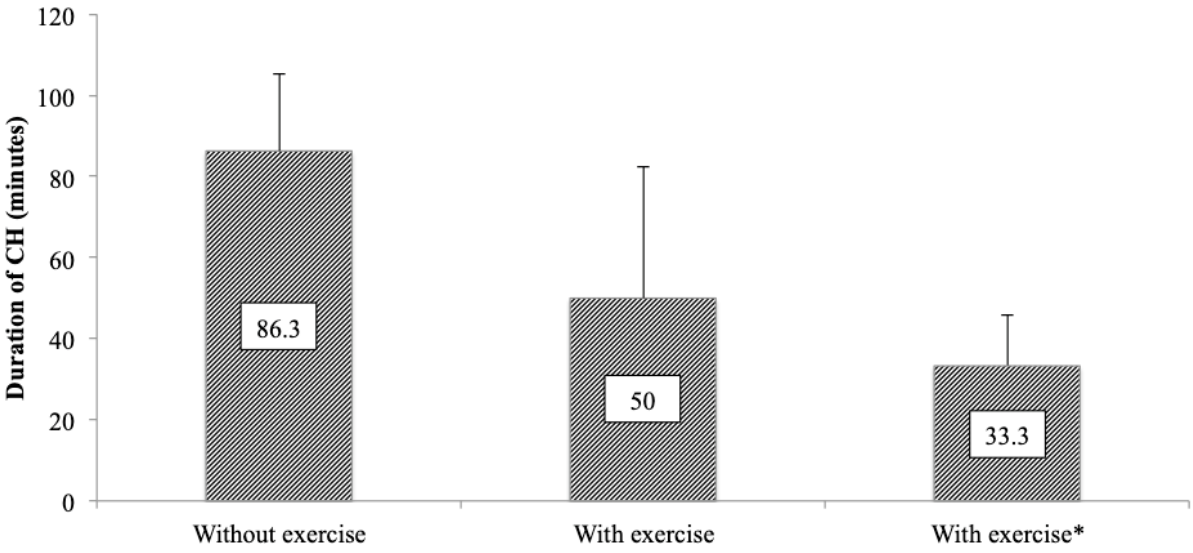

Figure 2. Duration of CH With or Without Exercise

Y axis represent the duration of CH ; X axis represent the condition : Without exercise, With exercise and With exercise [duration of CH attack with only the exercise sessions performed quickly after the onset of pain].*

SUPPLEMENTARY

Table S1. Short Form Survey-36 (SF-36) score and its individual component

SF-36 subscale	During CH	2 weeks after CH	6 weeks after CH	Mean population (mean **± SD**)*
Physical Functioning	95	100	100	70.6 ± 27.4
Role physical health	25	100	100	52.9 ± 40.8
Role emotional health	67	100	100	65.8 ±40.7
Energy / Fatigue	50	80	90	52.1 ± 22.4
Emotional well-being	64	84	84	70.4 ± 22.0
Social functioning	50	100	100	78.8 ± 25.4
Pain	22	100	100	70.8 ± 25.5
General health	75	80	90	57.0 ± 21.1
PCS	41.7	57.1	59.0	53.0 ± 7.2
MCS	42.4	54.4	54.4	50.1 ± 9.6

*SF-36 scores measured during CH (17 days after the beginning of the first symptoms), 2 week after and 6 weeks after the last symptom. PCS: physical component score; MCS: Mental component score. *Mean population values are from Stewart et al., 1992 and Hopman et al., 2000.*