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Case Report

Prevalence of Benign Paroxysmal Positional Vertigo Among Motocross Racers: A Case-Control Study

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Abstract

Objective: We aimed to determine the prevalence of benign paroxysmal positional vertigo (BPPV) among motocross racer after cross-country up and downhill activities.

Methods: This was a case control study in which 40 motocross racers and 40 age- and sex-matched healthy controls who had no hearing or balance problems were included. The Dix-Hallpike maneuver was applied to confirm the diagnosis of BPPV. Patients with BPPV were given the Epley maneuver for therapy (Epley, 1992), and followed up every week for one month for response assessment.

Results: Motocross racers (female/male, 11/39; age range, 21-43 years) and healthy control group (female/male, 10/30; age range, 22-43 years) were similar in terms of demographic and laboratory parameters. Four motocross racers (10%) had diagnosis of BPPV according to clinical findings and Dix-Hallpike maneuver outcome. However, none of the subjects in control group were diagnosed with BPPV (0%). Of the motocross racers with BPPV, three had unilateral, one had bilateral disease. For treatment of BPPV, the Epley maneuver was applied two times for two patients, and three times for the remaining two patients with BPPV. The time interval between the maneuvers was one week. In one month, there was no vertigo or nystagmus in any of the patients with BPPV.

Conclusion: Intensive motocross off-road bike is a cause of post-traumatic BPPV without head travma. Large-scale, randomised, controlled studies are needed to establish the post-traumatic etiology of BPPV in motocross off-road bikers.

Keywords: Benign Paroxysmal Positional Vertigo

Introduction

Benign paroxysmal positional vertigo (BPPV) is characterized by periods of vertigo triggered by a sudden change in the position of a person's head. It is the most common vestibular disorder; epidemiological studies showed that in the general adult population, the lifetime prevalence of BPPV is 2.4%, and the one-year prevalence is 0.6% [1, 2]. BPPV leads to significant morbidity, decrease in quality of life, depression, and medical costs [3]. Patients with BPPV were usually diagnosed and treated lately or inappropriately [4]. Presenting symptoms range from nystagmus with no apparent incapacitation to violent whirling sensation with nausea and vomiting after a positional change. Although the condition is termed "benign" the clinical presentation can be severe and incapacitating in certain situations.

BPPV is caused by abnormal mechanical stimulation and changed dynamics of the semicircular canals within the inner ear after sudden movement of head. Semicircular canals normally detect rotation of the head. In BPPV, calcite particles (otoconia), become dislocated and fall from the utricle to the semicircular canals. The disloged otoconia are believed to generate BPPV by stimulating the angular accelerometers of the head during its movements. Most common type of BPPV is posterior canal BPPV. Lateral canal and anterior canal BPPV are less common [5-7].

In young adults, BPPV usually occurs after head trauma probably due to concussive force that displaces the otoconia. Other reasons of BPPV are migraine, ototoxicity, viral infections, Ménière's disease, long term immobilization, ear operations, and whiplash injuries [8-10]. In people over age 50, BPPV generally results from natural age-related degeneration of the otolithic membrane [11].

Motocross is a kind of motorcycle racing held on enclosed off-road circuits in all-weather conditions. It has over hundred years history and growing popularity worldwide. Motocross is an organized sport in Turkey with national association governing the safety and competition of racers. However, it is a physically demanding sport with high risk of accidents that are most commonly associated with extremity injuries and closed head trauma [12, 13]. Although acute injuries during motocross racing has been reported extensively [14, 15], chronic effects of this high-risk sport have not been studied so far.

In this study, we thus aimed to determine the prevalence of BPPV among motocross racer after cross-country up and downhill activities. BPPV in motocross racers can be considered posttraumatic in origin. We performed the standard Dix-Hallpike maneuver and Pagnini-McClure maneuver to diagnose BPPV and to differentiate it from other conditions causing vertigo. Dix-hallpike maneuver is most appropriate for posterior and anterior canal BPPV. Pagnini-McClure is most appropriate for lateral canal BPPV [16]. We also treated patients diagnosed with BPPV with the Epley maneuver [17], which is the canalith repositioning procedure to restore equilibrium of the vestibular system using gravity.

Methods

Study design and patients

This was a case control study in which 40 motocross racers and 40 age- and sex-matched healthy controls who had no hearing or balance problems were included. None of the subjects had Menière's disease, migraine, or history of head trauma. Motocross racers have been using cross-motorbike minimally two hours at a time per two weeks for 7-12 years and did not complain of vertigo while using the motorbike.

All subjects were informed and gave written consent to be included in the study. The study was approved by Ethics Commitee, and all procedures were performed in accordance with latest version of Helsinki Declaration.

Study procedures and diagnosis of benign paroxysmal positional vertigo

Ear nose and throat examination, complete audiological tests, and blood analysis for thyroid-stimulating hormone(TSH), anti-thyroid peroxidase antibody(TPO-Ab) and anti-throglobulin antibosy(TG-Ab) and vitamin D levels were performed for all subjects in case and control groups.

The diagnosis of BPPV was based on history and clinical observation of a transient nistagmus during the positional maneuvers for BPPV of the posterior or horizontal the semicircular canals, elicited on the side of the affected ear. The Dix-Hallpike and Pagnini-McClure maneuver was applied to confirm the diagnosis of BPPV [16]. Nystagmus was investigated by Frenzel glasses. All patients had head shake and Romberg tests to check if there was unilateral vestibular weakness.

Patients with BPPV were given the Epley maneuver for therapy [17], and followed up every week for one month for response assessment. In the control examinations, ear nose and throat examination was performed and the Dix-Hallpike maneuver was repeated to see if vertigo and nystagmus still persisted.

Statistical analysis

Study data were summarized with descriptive statistics (e.g. mean, range, standard deviation, frequency, percentage). Risk of BPPV in each group was given with odds ratio (OR) with 95% confidence interval (CI).

Statistical analyses were performed using a computer software (Statistical Package for Social Sciences, Version 19.0, SPSS Inc., Chicago, Illinois, USA). Statistical level of significance was set to $p<0.05$.

Results

Motocross racers (female/male, 11/39; age range, 21-43 years) and healthy control group (female/male, 10/30; age range, 22-43 years) were similar in terms of demographic and laboratory parameters (Table 1).

Table 1. Clinical and demographic characteristics of motocross racers and control group.

		Motocross racers (n=40)	Control subjects (n=41)	p value
Age, *mean (range)*		32,03±5,73 (21-43)	33,24±6,14 (22-43)	0,359
Gender	Male	28 (%47,5)	31 (%52,5)	0,570
	Female	12 (%54,5)	10 (%45,5)	
Laboratory results (blood)	TPO-Ab(ng/mL)	136,55±21,38	143,59±21,26	0,142
	TG-Ab (ng/mL)	7,61±1,66	7,88±1,45	0,432
	TSH (mIU/L)	2,42±1,04	2,29±0,95	0,593
	Vit D (ng/mL)	31,15±5,19	31,85±6,90	0,606

TSH, thyroid stimulating hormone.

Table 2. Diagnosis and treatment of BPPV among motocross racers.

		Motocross racers (n=40)
BPPV diagnosis		4 (10%)
Affected side	Right	2 (50%)[a]
	Left	1 (25%)[a]
	Bilateral	1 (25%)[a]
Number of Epley maneuvers applied	Two maneuvers	2 (50%)[a]
	Three maneuvers	2 (50%)[a]

[a]Percentage of the patients with BPPV.

Ear nose and throat examination and audiological test results were normal in all subjects except four motocross racers (10%) who were diagnosed as having BPPV according to clinical findings and Dix-Hallpike maneuver outcome and vertigo complaint. These four patients had posterior canal BPPV. However, none of the subjects in control group were diagnosed with BPPV (0%). Of the motocross racers with BPPV, three had unilateral, one had bilateral disease (Table 2).

For treatment of BPPV, the Epley maneuver was applied two times for two patients, and three times for the remaining two patients with BPPV. The time interval between the maneuvers was one week. In one month, there was no vertigo or nystagmus in any of the patients with BPPV.

Discussion

BPPV is the most common cause of vertigo with unfavorable effects on productivity, daily activities, and quality of life of patients. Although pathophysiology of the disease has greatly clarified, etiology is still not known in almost half of cases [18]. In the present case-control study, we have shown for the first time that motocross sport is a precipitant factor for development of BPPV. In the literature, it has been found that there is a relation between insufficient vitamin D level and BPPV[19]. A relation has been found also between BPPV and autoimmune chronic thyroiditis[20]. We have added required blood tests to routine ear-nose-throat examination for Vit D level and autoimmune chronic thyroiditis to differentiate this causes of BPPV.

Two mechanisms underlying BPPV were suggested in literature: cupulolithiasis and canalithiasis [5-8]. In cupulolithiasis, the dislodged otoconia attach to the cupula of the posterior semicircular canals exciting or inhibiting the ampullary organ [5]. In canalithiasis, however, the otoconia freely float in the endolymph of the posterior semicircular canals creating a fluid pressure on the cupula, which then activates the ampullary organ [7]. Today, canalolithiasis theory is more commonly accepted theory than of cupulolithiasis. The main reason for this is that, with the cupulolithiasis theory, it is very difficult to explain the brief duration of nistagmus and vertigo during the Dix-Hallpike maneuver. Debris adhering to the cupula would cause the cupula to be deflected for a duration as long as the head remains in the provoking position. In addition, the cessation of vertigo after the Epley maneuver also suggests the canalolithiasis as a possible underlying mechanism [21, 22].

We believe that, by identification of situations that produce risk for BPPV, appropriate measures can be taken for prevention and early diagnosis. Therefore we aimed to determine the relation between motocross, a physically demanding sport with growing popularity, and PBBV in this case-control study.

Dix-Hallpike maneuver was considered a gold standard for the diagnosis of BPPV [21]. As far as treatment is concerned, the Epley maneuver, which is also known as the the canalith repositioning maneuver, has the high level of evidence as the most effective and long-lasting noninvasive treatment for BPPV [2, 23, 24]. Therefore, we applied Dix-Hallpike maneuver for diagnosis and Epley maneuver for treatment of BPPV in the present study.

Our results showed that BPPV is signficantly more common among motocross racers than age-matched control group. We also found that Epley maneuver effectively treated the BPPV, a finding which was in accordance with clinical trial and meta-analysis reports in literature [24-26].

What may be the pathophysiological mechanism of PBBV in motocross? We suggest that during intensive motocross race, due to the vertical acceleration of the head during jump and impact, such repeated acceleration-deceleration events migth generate displacement and/or dislocation of otoconia from the utricle. In such dislocation, the otoconia might be dispatched either into the posterior, horizontal or both semicircular canals, that causes typical symptoms of BPPV. The exact mechanism of PBBV among motocross racers or subjects performing similar sports/movements needs to be defined in further studies. In our laboratory tests we couldn't find any finding that can cause BPPV. All patients had normal Vit D blood levels and normal TPO-Ab, TG-Ab and TSH levels.

In conclusion, intensive motocross off-road bike is a cause of post-traumatic BPPV without head travma. Otolaryngological spesialist, as well as sport and trauma physicians, shoud be aware of this posible origin of post-traumatic vertigo in order to treat it with physiotherapetic maneuvers and to have objective findings in case of possible future insurance litigation. Large-scale, randomised, controlled studies are needed to establish the post-traumatic etiology of BPPV in motocross off-road bikers.

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