Original Article / Çalışma - Araştırma

Prevalence of benign paroxysmal positional vertigo among motocross racers: a case-control study

Motokros yarışçıları arasında benign paroksismal pozisyonel vertigo prevalansı: Olgu kontrollü çalışma

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ABSTRACT

Objectives: This study aims to investigate the prevalence of benign paroxysmal positional vertigo (BPPV) among motocross racers after cross-country up and downhill activities.

Patients and Methods: This case-control study included 40 motocross racers (39 males, 1 female; mean age 26 years; range 21 to 43 years) and 40 healthy controls (30 males, 10 females; mean age 28 years; range 22 to 43 years) who had no hearing or balance problems. The Dix-Hallpike maneuver was applied to confirm the diagnosis of BPPV. Patients with BPPV were administered the Epley maneuver every week for one month and followed-up for treatment response assessment.

Results: Motocross and control groups were similar in terms of demographic and laboratory parameters. While BPPV was detected in four motocross racers (10%) according to Dix-Hallpike maneuver outcome and clinical findings, there was no BPPV in the control group. Of the motocross racers with BPPV, three had unilateral, one had bilateral disease. Of these patients, Epley maneuver was applied two times in two patients and three times in the other two patients. There was no vertigo or nystagmus in any of the patients with BPPV in one month.

Conclusion: Intensive motocross activity is a cause of post-traumatic BPPV developing without head trauma. Large-scale, randomized controlled studies are needed to establish the post-traumatic etiology of BPPV in motocross racers.

Keywords: Motocross racers; repositioning maneuvers; vertigo.

ÖZ

Amaç: Bu çalışmada motokros yarışçıları arasında kros yarışında tepeye çıkış ve tepeden iniş aktiviteleri sonrası benign paroksismal pozisyonel vertigo (BPPV) prevalansı araştırıldı.

Hastalar ve Yöntemler: Bu olgu kontrollü çalışmaya 40 motokros yarışçısı (39 erkek, 1 kadın; ort. yaş 26 yıl; dağılım 21-43 yıl) ve işitme veya denge sorunu olmayan 40 sağlıklı kontrol (30 erkek, 10 kadın; ort. yaş 28 yıl; dağılım 22-43 yıl) alındı. Benign paroksismal pozisyonel vertigo tanısının doğrulanması için Dix-Hallpike manevrası uygulandı. Benign paroksismal pozisyonel vertigolu hastalara bir ay boyunca her hafta Epley manevrası uygulandı ve hastalar tedavi yanıtının değerlendirilmesi için takip edildi.

Bulgular: Motokros ve kontrol grupları demografik ve laboratuvar parametreleri açısından benzerdi. Dix-Hallpike manevrası sonuçlarına ve klinik bulgulara göre dört (%10) motokros yarışçısında BPPV saptanırken kontrol grubunda BPPV yoktu. Benign paroksismal pozisyonel vertigolu motokros yarışçılarından üçünde tek taraflı, birinde çift taraflı hastalık vardı. Bu hastalardan ikisine iki defa, diğer ikisine üç defa Epley manevrası uygulandı. Bir ay içinde BPPV'li hiçbir hastada vertigo veya nistagmus yoktu.

Sonuç: Yoğun motokros aktivitesi kafa travması olmadan oluşan post-travmatik BPPV'nin bir nedenidir. Motokros yarışçılarında BPPV'nin post-travmatik etyolojisinin tespiti için geniş ölçekli, randomize kontrollü çalışmalara ihtiyaç vardır.

Anahtar Sözcükler: Motokros yarışçıları; repozisyon manevraları; vertigo.

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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, with epidemiological studies showing a lifetime prevalence of 2.4%, and a one-year prevalence of 0.6% in the general adult population.[1,2] Benign paroxysmal positional vertigo 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.

Benign paroxysmal positional vertigo 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 dislodged otoconia are believed to generate BPPV by stimulating the angular accelerometers of the head during its movements.[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 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 a hundred years history and growing popularity worldwide. Motocross is an organized sport in Turkey with a 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 have been reported extensively,[14,15] chronic effects of this high-risk sport have not been studied so far.

In this study, we aimed to determine the prevalence of BPPV among motocross racers after cross-country up and downhill activities. Benign paroxysmal positional vertigo in motocross racers can be considered posttraumatic in origin. We performed the standard Dix-Hallpike maneuver to diagnose BPPV and to differentiate it from other conditions causing vertigo.[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.

PATIENTS AND METHODS

This was a case control study in which 40 motocross racers (39 males, 1 female; mean age 26 years; range 21 to 43 years) and 40 healthy controls (30 males, 10 females; mean age 28 years; range 22 to 43 years) who had no hearing or balance problems were included. Motocross racers were from Kemerburgaz motocross group. The control group was selected from patients admitted to the ear nose and throat (ENT) center of the Hospital. The study was performed between January 2013 and June 2013. None of the subjects had Ménière disease, migraine, or history of head trauma. Motocross racers had been using cross-motorbike minimally two hours at a time over 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.

Ear nose and throat examination, complete audiological tests, and blood analysis for thyroid function tests and vitamin D levels were performed for all subjects.

The diagnosis of BPPV was based on history and clinical observation of a transient nystagmus 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 maneuver was applied to confirm the diagnosis of BPPV.[16] Nystagmus was investigated using Frenzel glasses. All patients had head-shake and Romberg tests to check if there was unilateral vestibular weakness.

Patients with BPPV underwent the Epley maneuver for therapy,[17] and followed up every week for one month for response assessment. In the control examinations, ear nose and

Table 1. Clinical and demographic characteristics of motocross racers and controls

	Motocross racers (n=40)			Control subjects (n=40)			
	n	Mean±SD	Range	n	Mean±SD	Range	*p*
Age (years)		32	21-43		32.5	22-43	
Gender							
Male	39			30			
Female	11			10			
Laboratory results (blood)							
T_3 (ng/dL)		165.24±35			163.47±25		<0.05
T_4 (ng/dL)		11.7±43			12.1±34		<0.05
Thyroid stimulating hormone (mIU/L)		3.47±47			3.52±45		<0.05
Vitamin D (ng/mL)		52.7±46			54.4±56		<0.05

SD: Standard deviation.

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 Statistical Package for the Social Sciences IBM SPSS for Windows version 19.0 software program (IBM Corporation, Armonk, NY, USA). Statistical level of significance was set to $p<0.05$.

RESULTS

Motocross racers and the healthy control group were similar in terms of demographic and laboratory parameters (Table 1).

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. None of the control group subjects were diagnosed with BPPV (0%). Of the motocross racers with BPPV, three had unilateral and 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. The time interval between maneuvers was one week. In one month, there was no vertigo or nystagmus in any of the patients with BPPV.

DISCUSSION

Benign paroxysmal positional vertigo is the most common cause of vertigo with unfavorable effects on productivity, daily activities, and quality of life of patients. Although the pathophysiology of the disease has been greatly clarified, the etiology is still not known in almost half of cases.[18] The present case-control study suggests that motocross sport may be a precipitating factor for development of BPPV.

Two mechanisms underlying BPPV are suggested in the 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

Table 2. Diagnosis and treatment of benign paroxysmal positional vertigo among motocross racers

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

BPPV: Benign paroxysmal positional vertigo; * Percentage of the patients with BPPV.

posterior semicircular canals creating a fluid pressure on the cupula, which then activates the ampullary organ.[7] Today, the canalithiasis theory is more commonly accepted theory than cupulolithiasis. The main reason for this is that with the cupulolithiasis theory, it is very difficult to explain the brief duration of nystagmus and vertigo during the Dix-Hallpike maneuver. Debris adhering to the cupula would cause the cupula to be deflected for as long as the head remains in the provoking position. In addition, the cessation of vertigo after the Epley maneuver also suggests canalithiasis as a possible underlying mechanism.[19,20]

We have the impression 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 BPPV 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 canalith repositioning maneuver, has a high level of evidence as the most effective and long-lasting noninvasive treatment for BPPV.[2,21,22] Therefore, we applied Dix-Hallpike maneuver for diagnosis and Epley maneuver for treatment of BPPV in the present study.

Our results suggest that BPPV is significantly more common among motocross racers than an age-matched control group. We also found that the Epley maneuver effectively treated BPPV, in accordance with clinical trials and meta-analyses.[22-24]

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 might 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 BPPV among motocross racers or subjects performing similar sports/movements needs to be defined in further studies.

In conclusion, intensive motocross off-road biking may be a cause of post-traumatic BPPV without head trauma. Otolaryngological specialists, as well as sport and trauma physicians, should be aware of this possible origin of post-traumatic vertigo in order to treat it with physiotherapeutic maneuvers and to have objective findings in case of possible future insurance litigation. Large-scale, randomized, controlled studies are needed to establish the post-traumatic etiology of BPPV in motocross off-road bikers.

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