Profound Olfactory Impairment in Idiopathic Intracranial Hypertension

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Background

Many long-duration astronauts develop symptoms and signs consistent with intracranial hypertension including headaches, papilledema, nasal congestion, and impaired taste and olfactory function. We prospectively evaluated olfactory function in patients with idiopathic intracranial hypertension (IIH) and the effect of six-degree head-down tilt (HDT) as ground-based space-flight analogs.

Methods

IIH and control subjects matched for age, sex and weight were enrolled for olfactory testing at the Center for Space Medicine, Baylor College of Medicine, Houston, Texas in a one year prospective study. Olfactory function was tested in upright (90 degrees) and six-degree HDT in all subjects using two different measures: University of Pennsylvania Smell Identification Test (SIT) and Olfactory Threshold (OT) with phenylethyl alcohol (PEA). The SIT measures ability to identify smells, while the OT determines minimum detection threshold of an odorant. We hypothesized that IIH patients would have impaired olfactory performance for both measures, but worse on the OT due to presumed peripheral olfactory structures being more affected given the proximity between the olfactory and cerebrospinal fluid (CSF) drainage pathways. We also hypothesized that HDT would worsen the olfactory performance. We also collected retrospective data from neuro-ophthalmology clinic visits including optical coherence tomography (OCT), Frisen grading, Humphrey visual fields (VFs), optic nerve sheath diameter (ONSD), duration of symptoms, and ICP values.

Table 1. Demographic and Clinical Characteristics of Subjects*

	IIH (n=19)	Controls (n=19)	p-value
Age	42.8 (13.8)	43.3 (12.8)	0.91
Sex (female)	18 (94.7%)	18 (94.7%)	1.00
Weight (kg)	103.9 (31.2)	90.3 (17.5)	0.11
Height (inches)	64.9 (3.7)	65.1 (3.7)	0.89
Blood pressure (mmHg):			
Systolic upright	126.2 (15.2)	129.5 (21.5)	0.59
Diastolic upright	86.0 (10.6)	85.4 (14.6)	0.90
Systolic tilt	127.3 (18.9)	131.4 (18.3)	0.52
Diastolic tilt	83.3 (11.2)	82.5 (12.0)	0.84
Heart rate (beats/min):			
Upright	77.7 (12.5)	79.2 (11.1)	0.70
Tilt	72.1 (11.2)	73.9 (9.9)	0.62
Hypertension	4 (21.1%)	2 (10.5%)	0.37
Hyperlipidemia	5 (26.3%)	3 (15.8%)	0.43
Diabetes mellitus	3 (15.8%)	3 (15.8%)	1.00
Asthma	2 (10.5%)	1 (5.3%)	0.55
Subjective sense of smell ±	4.5 (0.84)	4.4 (1.43)	0.78

Abbreviations: BMI = body mass index; IIH = idiopathic intracranial hypertension
*Data are means (SD) or numbers (%), unless otherwise specified
± This was a pre-testing self-assessment of sense of smell: 1 = very poor, 2 = poor, 3 = below average, 4 = average, 5 = above average, 6 = excellent, 7 = outstanding

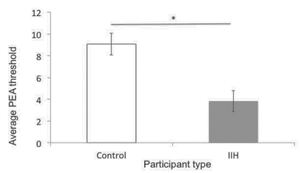
Results

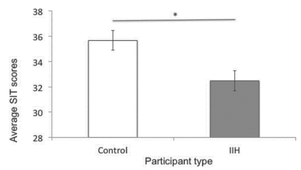
Nineteen IIH subjects, mostly women (95%)(n=18) and 19 age, sex and weight matched controls were enrolled (Table 1). IIH subjects performed significantly worse on both olfactory measures compared to control subjects (Fig 1). The OT dilution levels were [3.83 (95% CI 7.04-11.10) and 9.07 (95% CI 1.85-5.81), p=0.001] for IIH and controls respectively. The difference of 5 dilution levels of 1:2 represents a 32 fold difference in concentration for PEA detection in IIH versus control subjects. The SIT scores were [32.47 (95% CI 30.85-34.09) vs. 35.61 (95% CI 34.03-37.18), p = 0.008)] for IIH and controls respectively (Fig 2). The OT detection was mildly impaired by HDT compared to upright positioning in the combined subjects [6.05 (95% CI 4.58-7.51) vs. 6.85 (95% CI 5.43-8.27), p =0.004](Fig 3). We observed a significant inverse correlation between SIT scores and ONSD (both eyes averaged)(Pearson coefficient, r = -0.73 and -0.64, p = 0.009 and 0.018), for upright and HDT positions respectively. Furthermore, IIH patients with a longer duration of symptoms had worse performance on both the SIT (-0.52, p =0.0001 for the upright body position) and OT testing (-0.61 and -0.56, p =0.0001 for the upright and HDT body positions, respectively). We did not find any significant correlations between olfactory performance and previous ICP value, OCT derived RNFL thickness, VF defects, or Frisen grade.

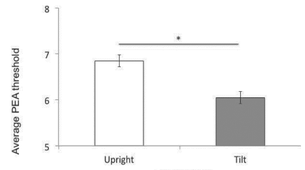
Figure 1

Figure 2

Figure 3







Conclusions

We report a marked impairment of olfactory function in IIH patients compared to controls, more prominent with OT detection, but moderately decreased for identification. HDT worsened olfactory function for the OT detection, but not identification. Larger prospective studies are indicated to further explore the relationship between elevated ICP and CSF disorders and olfactory systems.

Acknowledgments

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