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Case Report

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Semicircular Canal Functions Throughout Pregnancy: Case series using Video Head Impulse Test (vHIT)

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Abstract

Pregnancy involves several anatomic and functional changes in several organs including the vestibular system. Symptoms such as unsteadiness, dizziness and vertigo are reported by pregnant patients. However, there is a lack of evidence about the vestibular functional and anatomic changes throughout the pregnancy. Some studies have detailed unilateral deficits, increased, and decreased gains and increased amplitudes in some vestibular testing including videonystgamography, Cervical Vestibular Evoked Myogenic Potential (cVEMP) and Video Head Impulse Test (vHIT). Herein, we assessed the semicircular canal function of eight pregnant females using vHIT throughout pregnancy to describe the changes to these vestibular structures starting at the 20th week of gestation.

Keywords: Clinical health communication; Obstetrics; Pregnancy; Vestibular function tests; Vestibular system

Background

During pregnancy, the body goes through diverse changes that involve all organ systems including the vestibular system [1]. Physiological adaptations occur during pregnancy such as fluid retention in endolymph and perilymph, hypercoagulability, and the direct effect of sexual hormones to inner ear structures[2]. Hormonal changes during pregnancy may alter the homeostasis and enzymatic processes at the anterior and posterior labyrinth leading to the presentation of audiovestibular symptoms[3]. Starting the 20th week of gestation until labor, estrogens and progesterone are significantly increased leading to electrolytic imbalance, excessive water and sodium retention, and volumetric changes within critical structures for balance such as the semicircular canals, endolymphatic sac, utricle, and saccule[4,5]. Vestibular tests offer insights into vestibular physiology, function of vestibulo-ocular reflex (VOR) , site of lesion, extent of vestibular lesions, level of compensation and functional integration of sensory inputs[6]. An objective, quick and non-invasive test for assessing the function of the semicircular canals based on the examination of the VOR called Video head Impulse Test (vHIT) have been used in pregnant females to assess the functional shifts in the vestibular system [6-8]. Even though, specific changes such as increased gains in the lateral semicircular canals have been described in pregnant patients[7], there is no available data about the objective assessment of the semicircular canals function throughout pregnancy. Herein, we assessed the function of the semicircular canals throughout pregnancy in 8 pregnant females over 20th of gestational week using vHIT with a follow-up of eight weeks.

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Materials and methods

Study type and population

A case-series study was conducted in pregnant women admitted to the Gynecology and Obstetrics Department and Maternal-Fetal Unit of Clínica Universitaria Bolivariana - Universidad Pontificia Bolivariana from April to June 2023Participants were informed about the study, and informed consent was obtained. Pregnant patients over 18 years of age over the 20th week of gestation without arterial hypertension, diabetes mellitus type I/II, hyprothyroidism, hyperemesis gravidarum, rheumatologic conditions or oncologic disorders and those who consented to have a weekly follow-up were included in the study.

Patients with previous neurotologic conditions, such as Meniere's disease, vestibular neuritis, benign paroxysmal positional vertigo, unilateral or bilateral vestibulopathy, vestibular schwannoma, vestibular migraine, superior canal dehiscence or inner ear malformations, were excluded from this study. Patients with facial fractures, ocular disorders zygomatic fractures, cervical fractures, and limitations for clinical head impulse tests, as well as patients under benzodiazepines, anxiolytics, or sleep medications, were also excluded.

The study received approval from the Health Research Ethics Committee of the Universidad Pontificia Bolivariana (approval number 12/2022). Participants were informed about the study and informed consent was obtained.

Variables

Demographic data, including weeks of gestation, number of pregnancies, and previous history of vertigo were obtained. Gains in the lateral, anterior and posterior canals and lateral, left-anterior and right posterior, and, right-anterior and left-posterior were also included.

Statistical analysis

All statistical analyses were performed using GraphPad Prism 9.0 (San Diego, CA, USA). An ANOVA test was performed to evaluate semicircular canal changes throughout pregnancy given by the gain and asymmetry in a follow-up of eight weeks in eight patients.

Video Head Impulse Test (vHIT)

A weekly examination during eight weeks was performed in 8 pregnant with gestational weeks over 20th week of pregnancy. The vHIT device used for this study was EyeSeeCam (Interacoustics, VOG, Munich, Germany; model 2022) [9].

Pregnant were placed on a static surface at a fixed distance of 2 meters from the back of the chair to one point of fixation on the wall. The room was settled and well-lit to ensure small pupils in each patient[10]. An interchangeable eyeglass integrated into a camera system to record eye movements was used. An experimented otolaryngologist fully trained in Otoneurology stood behind the patient, holding the head firmly during head impulses. Patients were instructed to keep open their eyes and look to the fixation point on the wall, and relax their necks. Head impulses comprised fast horizontal rotational head movements (>120°/s) with a low amplitude, unpredictable in timing and direction[11]. EyeSeeCam software calculated VOR gains and asymmetry. The normal VOR gain for vHIT is 1.0 [9,12]. The cutoff value for abnormal VOR gain is less than 0.8. Gain asymmetry is calculated based on the formula (gain asymmetry = [left side gain − right side gain]/[left side gain + right side gain]) and is expressed as a percentage using standardized historical methods [12].

Patients with significant unilateral or bilateral vestibular function loss moved their eyes away from the target when their head was pushed in the direction of the damaged labyrinth, and a corrective saccade was observed when the head was pushed (covert saccade) or immediately after the head was pushed (overt saccade) [12]. The main outcome measures for vHIT were the mean gain of VOR for each canal - right anterior (RA), right lateral (RL), right posterior (RP), left anterior (LA), left lateral (LL), left posterior (LP) - and the gain asymmetry of left lateral-right lateral (LLRL), left anterior-right posterior (LARP), and right anterior-left posterior (RALP) [12].

Results

Demographical characteristics of patients are summarized in Table 1. Mean age was 24.8 (SD 4.3) and gestational weeks ranged from 20.6 to 32.4 (mean gestational week 26, SD: 12.3). Primiparity was often reported in this population (62.5%).

We used a VOR gain cutoff value of 0.8, and we compared gains versus weeks of gestation. Data regarding VOR gains of each semicircular canal of the patients are shown in Table 2.

VOR gains shown a significant ascending trend line in all patients in the lateral (p <0,0001) and anterior (p=0,0007) canals (Figure 1 and 2). Posterior semicircular gains shown a significant and variable trend throughout pregnancy (p=0,0037) (Figure 3).

No overt or covert saccades were detected in any of the patients included in this study.

Neither VOR gain asymmetry was detected in the lateral, posterior, or anterior plane. No significant increase in asymmetry was detected in LARP, RALP, or lateral planes throughout pregnancy. Data is described in Table 3. No overt or covert saccades were detected in any of the patients included in this study.

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Table 1: Demographics of pregnant patients with follow-up

Patient #	Age	Gestational Age (week) at First Visit	Parity	Vertigo during current pregnancy	Previous Vertigo during other pregnancies
1	27	20.6	Primiparity	No	No
2	21	21.4	Multiparity	No	No
3	32	23.2	Primiparity	No	No
4	25	25.4	Multiparity	No	No
5	19	25.6	Primiparity	No	No
6	24	27.4	Primiparity	No	No
7	29	31	Multiparity	No	No
8	22	32.4	Primiparity	No	No

Table 2: Gain changes throughout pregnancy in the lateral, posterior and anterior canals

Patient	Gestational Weeks (Initial)	Follow-up Week							
		1	2	3	4	5	6	7	8
		Lateral Semicircular Gain (Mean)							
1	20.6	0,76	0,79	0,82	0,91	1,05	1,12	1,2	1,23
2	21.4	0,95	1,03	1,1	1,15	1,15	1,2	1,23	1,34
3	23.2	1,1	1,1	1,21	1,26	1,28	1,02	1,25	1,36
4	25.4	**1,2**	1,26	1,27	1,3	1,3	1,35	1,37	1,4
5	25.6	**1,08**	1,2	1,25	1,28	1,3	1,37	1,4	1,45
6	27.4	**1,15**	1,2	1,28	1,35	1,4	1,42	1,5	1,52
7	31	**1,2**	1,25	1,22	1,3	1,48	1,5	1,52	1,55
8	32.4	**1,27**	1,29	1,31	1,4	1,42	1,42	1,57	1,55
		Anterior Semicircular Gain (Mean)							
1	20.6	0,65	0,93	0,8	0,89	0,99	1,1	1,05	1,11
2	21.4	0,7	0,78	0,76	0,88	0,93	1,05	1,11	1,2
3	23.2	0,88	0,88	0,94	0,96	1,1	1,12	1,2	1,23
4	25.4	0,9	0,9	0,91	0,94	0,98	1	1	1,01
5	25.6	0,92	0,92	0,88	1,01	1,12	1,2	1,23	1,24
6	27.4	1	1	1,01	1,08	1,1	1,2	1,2	1,21
7	31	1,05	1,07	1,07	1,11	1,12	1,18	1,17	1,19
8	32.4	1,04	1,04	1,11	1,13	1,15	1,2	1,15	1,2
		Posterior Semicircular Gain (Mean)							
1	20.6	0,6	0,65	0,66	0,78	0,8	0,83	0,92	0,98
2	21.4	0,76	0,88	0,89	1,01	1,05	1,11	1,17	1,12
3	23.2	0,8	0,85	0,85	0,92	0,98	1	1,02	1,07
4	25.4	0,81	0,9	0,93	0,99	1	1,01	1,13	1,2
5	25.6	0,84	0,9	0,92	0,92	1	1	1,01	1,03
6	27.4	0,92	0,94	0,99	1	1	1,02	1,03	1,14
7	31	1	1	1,05	1,06	1,1	1,13	1,2	1,25
8	32.4	1,2	1,25	1,12	1,2	1,24	1,08	0,99	0,94

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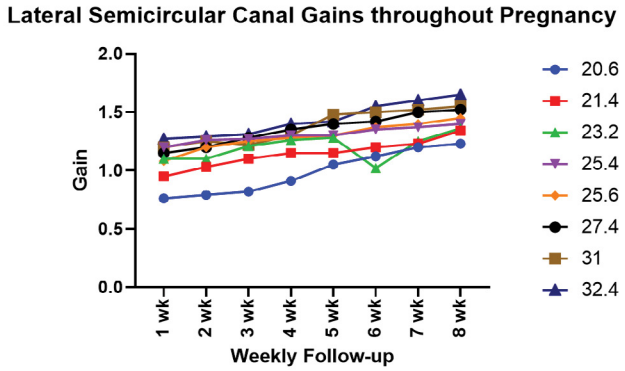

Figure 1: Lateral Semicircular canal Gains throughout Pregnancy

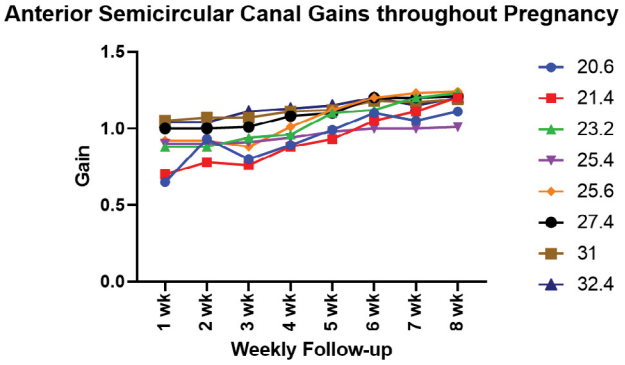

Figure 2: Anterior Semicircular Canal Gains throughout Pregnancy

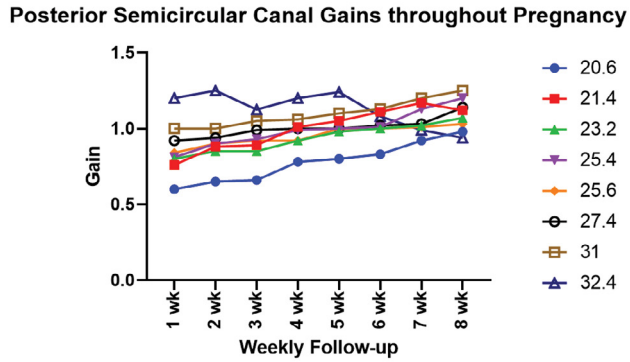

Figure 3: Posterior Semicircular Canal Gains throughout Pregnancy

Table 3: Asymmetry

	Initial Asymmetry							
	20.6	**21.4**	**23.2**	**25.4**	**25.6**	**27.4**	**31**	**32.4**
Lateral	7,2	10	4	5,1	10	12	3,4	6
LARP	5	3,5	1	6	7,4	11	13	20,5
RALP	5	3	8,5	10	4	11,4	9	13
	8-week Asymmetry							
Lateral	8	14	6	9,3	11,7	24	6	8,5
LARP	6,2	6	1,5	9	12	17	15	25,1
RALP	6,7	7,5	10	11,2	8,9	15	13,6	17,6

Discussion

An ascending trend line was observed in gains on the lateral and anterior canals throughout pregnancy starting at 20th week in a follow-up of eight weeks. Posterior canal shown also a variable and significant trend. No significant asymmetry was observed when compared the initial week of follow-up using vHIT to last visit. This is the first case-series study to reveal these findings in one Gynecology and Obstetrics Department and Maternal-Fetal Unit.

To date, two studies have been conducted in pregnant females to assess the vestibular function using vHIT. Findings described presented some challenges and critical facts in this population. One was focused on patients with hyperemesis gravidarum, which is a critical condition that may lead to electrolytic dysfunction and affect the homeostasis of the endolymph and perilymph in the anterior and posterior labyrinth[8]. Low gain values of the left anterior canal and higher asymmetry in the LARP were reported[8]. Besides the electrolytic disturbances, this study did not present a follow-up throughout time[8]. A cross-sectional study was conducted in one Maternal-Fetal Unit using vHIT in patients without otologic, cardiovascular, renal, or metabolic disorders. This presented an increase in gains in the lateral canals[7]. No other findings were observed in posterior or anterior canals[7]. No asymmetry was reported in this group.

Hormonal influx and electrolytic dysregulation starting at the 20th week of gestation are common facts potentially involved in the results given in both studies[13]. However, these presented a non-synchronic vHIT assessment of patients in different gestational weeks and did not present a prospective follow-up. This is the first study to present a follow-up in pregnant females starting at 20th week using vHIT to assess the vestibular changes to the semicircular canals throughout pregnancy. These changes observed may reveal a variability into the endolymphatic and perilymphatic fluid, also may suggest anatomic changes within the semicircular canals leading to increased gains[3,7,13]. Another consideration is the inflammation seen in several organs throughout pregnancy[3].

Some limitations are found in this study. First this is a case-series study with a limited sample. This is due to the lack of consent of patients to be followed within eight weeks or more. This is one of the most relevant challenges faced when we tried to include more patients. Second, there is a lack of literature including prospective studies and vestibular assessments during pregnancy. Further studies including extensive patient population samples are suggested to get a better understanding of anatomic and functional changes from first trimester to labor.

Conclusion

Significant ascending trends lines in lateral and anterior

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canal gains throughout pregnancy in a case-series study was observed. Posterior canal gains were also described but were more variable without a specific trend. Increased gains are potentially associated with volumetric and functional changes within the posterior labyrinth. Further prospective studies with bigger samples and histopathologic studies are needed to get a better understanding of vestibular system changes during pregnancy.

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Conflicts of interest

None

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None

References

1. Pascual ZN, Langaker MD. Physiology, Pregnancy. [Updated 2023 May 16]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK559304/

2. Frosolini A, Marioni G, Gallo C, et al. Audio-vestibular disorders and pregnancy: A systematic review. Am J Otolaryngol 42 (2021): 103136.

3. Serna-Hoyos LC, Herrón Arango AF, Ortiz-Mesa S, et al. Vertigo in Pregnancy: A Narrative Review. Cureus 14 (2022): e25386.

4. Sennaroglu G, Belgin E. Audiological findings in pregnancy. J Laryngol Otol 115 (2001): 617-621.

5. Wu PH, Cheng PW, Young YH. Inner ear disorders in 68 pregnant women: a 20-year experience. Clin Otolaryngol 42 (2017): 844-846.

6. MacDougall HG, Weber KP, McGarvie LA, et al. The video head impulse test: diagnostic accuracy in peripheral vestibulopathy. Neurology 73 (2007): 1134-1141.

7. Castillo-Bustamante M, Espinoza I, Briceño O, et al. Vestibular Findings on the Video Head Impulse Test (vHIT) in Pregnancy: A Cross-Sectional Study. Cureus 15 (2023): e41059.

8. Tulmaç ÖB, Kılıç R, Yaman S, et al. Evaluation of the vestibular system with video head impulse test in pregnant women with hyperemesis gravidarum. J Obstet Gynaecol Res. 2021 Jan;47(1):96-102.

9.InteracousticsManual.[Jun;2023].2022. https://www.interacoustics.com/images/files/8501166_d_0112391_g_2022_04_es_sera_instructions_for_use.pdf

10. Castro P, Sena Esteves S, Lerchundi F, et al. Viewing Target Distance Influences the Vestibulo-Ocular Reflex Gain when Assessed Using the Video Head Impulse Test. Audiol Neurootol 23 (2018): 285-289.

11. Park JW, Kim TS, Cha EH, et al. Differences in video head impulse test gains from right versus left or outward versus inward head impulses. Laryngoscope. 129 (2019): 1675-1679.

12. Weber KP, MacDougall HG, Halmagyi GM, Curthoys IS. Impulsive testing of semicircular-canal function using video-oculography. Ann N Y Acad Sci 1164 (2009): 486-491.

13. Castillo-Bustamante M, Del Cid Chua C, Vázquez M, Bello Dotel L, Baez Recalde M. Hormonas sexuales y alteraciones neurotológicas en Mujeres [Estrogen and neurotological diders in womenSexual hormones and neurotological disorders in women]. Rev Fac Cien Med Univ Nac Cordoba 77 (2020): 351-355.