

Review Article

Audiovestibular manifestations during pregnancy: a review

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ABSTRACT

Pregnancy is nine-month duration physiological process with psychological, cardiovascular, and hormonal changes that affects different organs of the pregnant women. Any organs of the body can be affected during pregnancy due to hormonal changes so as in audiovestibular system. There are several audiovestibular manifestations occur during pregnancy such as hearing loss, otosclerosis, tinnitus, autophony, facial nerve palsy, and vertigo manifested as first time or get exacerbated during pregnancy. Majority of the changes during pregnancy are harmless to the mother and fetus, whereas some may cause pathological manifestations. The hormonal changes during pregnancy can cause alteration in the homeostasis of the inner ear fluids and hamper the inner ear functions. The changes of estrogen and progesterone levels during pregnancy can affect the audio-vestibular system. These changes in the inner ear may manifest with symptoms like vertigo, tinnitus, fullness in the ear, and hyperacusis. These symptoms in the pregnancy directly affects the quality of life both physically and emotionally. There are no standard guidelines for the management of audiovestibular manifestations. However, there are very little data available for audiovestibular manifestations during the pregnancy period. The objective of this review article is to discuss the prevalence, etiopathology, and clinical presentations, diagnosis and treatment of audiovestibular manifestations during pregnancy.

Keywords: Pregnancy, Audiovestibular manifestations, Hearing loss, Otosclerosis, Benign paroxysmal positional vertigo

INTRODUCTION

There are several physiological changes in women's body during pregnancy that affect all the organs including sensory ones. Due to changes of the body physiology during pregnancy, there are myriad of symptoms manifested by pregnant women. The release of certain neurotransmitters during pregnancy can lead to changes in the biochemical level in the labyrinth and produce certain neuro-otological symptoms.¹

Any injury to the inner ear results in hearing impairment and balance abnormalities. Audiological disease like otosclerosis was the first clinical entity of the ear documented during pregnancy, at the beginning of the last century.² After that, clinicians have been wondering if the physiological adaptation happening in pregnancy

and high-risk pregnancy could be a cause for audiovestibular system disorders.

During pregnancy, modulation of the immune system resulting in viral reactivation, fluid retention in perilymph and endolymph, hypercoagulability, and direct impact of sexual and gestational hormones on the audiovestibular system were pathophysiological mechanisms that have been thought as responsible during pregnancy for diseases like Meniere's disease, tinnitus, sudden sensorineural hearing loss, eustachian tube dysfunction, benign paroxysmal positional vertigo and vestibular schwannoma.³ Currently, there are no guidelines for the management of audiovestibular manifestations in pregnancy. Little has been reported about audiovestibular manifestations during pregnancy. We performed a narrative review of audiovestibular manifestations in pregnant women.

Methods of literature search

Current research publications on audiovestibular manifestations during pregnancy were found using a variety of methodical methodologies. We began by conducting an online search of the Scopus, PubMed, Medline, and Google Scholar databases. PRISMA (preferred reporting items for systematic reviews and meta-analysis) standards were used to create a search strategy. Other research articles were discovered manually from the citations using this search approach, which recognized the abstracts of published works. Eligible studies included randomized controlled trials, observational studies, comparative studies, case series, and case reports. The total number of articles was 88 (22 case reports; 16 cases series; 30 original articles) (Figure 1).

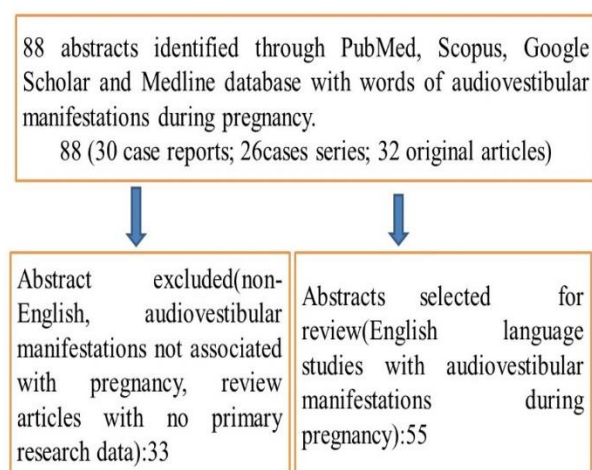


Figure 1: Flow chart showing method of literature search.

This paper focuses solely on audiovestibular manifestations during pregnancy. This research looks at the prevalence, etiopathology, clinical manifestations, diagnosis, and treatment of audiovestibular manifestations during pregnancy. This research lays the groundwork for future prospective trials on audiovestibular manifestations during pregnancy. It will also serve as a springboard for further research on audiovestibular manifestations in pregnant women.

Epidemiology

Audiovestibular symptoms are common clinical presentations by the patients at the outpatient department otorhinolaryngology. Common auditory symptoms experienced by the pregnant women are tinnitus, aural fullness and hearing impairment.⁴ Tinnitus is the commonest auditory symptom presented during pregnancy.⁴ Approximately 80% of the global population has presented with vertigo, at least one episode of vertigo in their lifetime, and it is considered as the commonest clinical symptom in the emergency department and office

consultations.⁵ The yearly incidence of vertigo worldwide is nearly 7% and rises up to 30% per annum.⁵ Vertigo is more commonly found during the first trimester followed by the second trimester where instability and gait imbalance are more common.⁶ In the third trimester, instability/imbalance is more frequent followed by a tendency to fall.⁶ The exacerbation of Meniere's disease (MD) is often found in the third trimester of pregnancy in up to 57% of the patients, and vestibular migraine (VM) in up to 50% of the patients.⁷ BPPV is the most common cause of vertigo in the general population and accounts for 20 to 40% of all case, with a reported incidence of 0.6% per annum, a prevalence between 10.7 and 64.0 cases per one lakh and a lifetime prevalence of 2.4%.⁸

Etiopathology

During pregnancy, there are several changes of the pregnant women modulated by hormones including estrogen, progesterone, human chorionic gonadotropin, placental lactogen, and relaxing; resulting in anatomic and functional changes in the cardiovascular, respiratory, gastrointestinal, musculoskeletal, cutaneous and audiovestibular systems.³ The physiological changes that happen in the body of pregnant women have been considered as possible cause for developing audiovestibular disorders.³

Estrogen and progesterone can cause changes in the mucosal membrane at the nasal and nasopharyngeal area, resulting in nasal discharge, nasal blockage and eventually eustachian tube dysfunction manifesting the aural fullness and autophony in the pregnancy.⁹ The otosclerotic foci is stimulated by the estrogen which results in osteocytic activity and ossifies the otospongiotic lesions. The exact etiology of otosclerosis is still not known. It widely thought that its pathophysiology is multifactorial with several possible factors involved such as genetic factors, viruses, autoimmunity, inflammatory states and hormones.¹⁰ The hormonal factors can aggravate the otosclerosis during pregnancy.¹⁰

During pregnancy, retention of the fluid in endolymph and perilymph, modulation of the immune system leading to viral reactivation, hypercoagulability, and direct effect of gestational hormones on the labyrinthine system are some pathophysiological mechanisms that have been suggested as responsible for certain audiovestibular manifestations in pregnancy such as Meniere's disease, sudden sensorineural hearing loss, eustachian tube dysfunction, benign paroxysmal positional vertigo, and vestibular schwannoma.¹¹ Although the mechanism for reduced serum osmolality in early pregnancy remains unknown, aggravates the vertigo episodes in MD. The sudden decline of serum osmolality induces an osmotic gradient between the outer and inner endolymphatic sac so that free water can enter the endolymphatic sac, leading to exacerbation of endolymphatic hydrops. The exact pathophysiology of the BPPV during pregnancy is

still debated. Trauma to the head contributes to the etiology of about half of the patients with BPPV.¹² Prolonged bed rest is also thought of as the etiology of BPPV.¹³ Recently, there are reports that calcium and vitamin D metabolism disorders act as risk factors for BPPV. Calcium and vitamin D metabolism is often affected in pregnancy, particularly in the late trimesters because of the rapid growth of the fetus. This may be an important risk factor for pregnant females suffering from BPPV.¹⁴ BPPV has multiple etiologies, but hormonal abnormalities or hormonal changes as aggravating factors are not enough to explain the etiology in pregnancy.

Auditory manifestations

Otosclerosis: there are higher serological levels of growth hormones variant (GH-V) on the otosclerosis women with pregnancy in comparison to control group.¹⁰ Moreover, there is positive correlation was documented between the serum levels of GH-V and the entity of air-bone gap in pure tone audiometry.¹⁵ The initial results favored that GH-IGF axis can play a role for occurrence of otosclerosis during pregnancy. However, further studies are required to confirm this hypothesis.

Tinnitus: ringing sound in the ear or tinnitus is a common auditory symptom presented by pregnant mother. Tinnitus is the most frequent auditory symptom in pregnant women.¹⁵ The tinnitus during pregnancy may be due to increased perilymphatic fluid pressure, hyperdynamic circulation, and hormonal changes.¹⁶ In one study, approximately 33% of the pregnant mother presented with tinnitus in comparison to 11% of the nonpregnant women in control group with resolution of symptoms after delivery.¹⁷

Severe symptoms of tinnitus during pregnancy resulted early cesarean delivery at 34 weeks with relieve of tinnitus after delivery.¹⁸ Tinnitus may an early sign of gestational hypertension or preeclampsia and such cases should be carefully monitored.¹⁹ Sudden sensorineural hearing loss: sudden sensorineural hearing loss is less commonly found in pregnancy but sometimes presented by pregnant women due to toxemia. In pregnancy, increased estrogen leads to hypercoagulability an occlusion of the labyrinthine vessels and microcirculation can cause in sudden sensorineural hearing loss. Viral cause of sudden sensorineural hearing loss should be ruled out. Eustachian tube dysfunction: the eustachian tube dysfunction during pregnancy may occur due to mucosal edema in the nose and nasopharynx which leads to obstruction of the eustachian tube and otitis media with effusion. The clinical manifestations include feeling of blockage in the ear and decreased hearing of the pregnant women.²⁰

Vestibular manifestations

Benign paroxysmal positional vertigo: Benign paroxysmal positional vertigo (BPPV) is a common

clinical entity characterized by sudden, brief paroxysmal attacks of rotation vertigo occurred by changing the head position.²¹ In BPPV, there is degenerative debris dislocated from the utricle into the semicircular canals increasing the density of the cupula.²² This may occur either when the deposits are abnormally attached to the cupula (cupulolithiasis) or when the dense particles freely float in the endolymphatic fluid in the semicircular canals (canalolithiasis).²² Estrogen alteration is thought to impair endolymphatic fluid electrolytes concentration, resulting in degeneration of otoconial fibers, or induce endolymphatic pH liabilities, causing degeneration of otoconia.²³

Meniere's disease (MD): it is a vestibular disorder with clinical presentations of vertigo, tinnitus, fullness in the ear, and sensorineural hearing loss.²⁴ It occurs due to abnormalities in the regulation of endolymphatic fluid in the labyrinth leading to obstruction, so increased endolymphatic sac pressure.²⁴ There are some environmental, metabolic, and genetic causes associated with MD.²⁴ During pregnancy, there is reduction in the osmolality of systemic and local fluids in the inner ear, leading to a raised and turbulent osmotic gradient known as hydrops to the endolymphatic sac, saccule, cochlea and the semicircular canals.²⁵

In pregnancy, MD has often attributed to the acute onset of vertigo or hearing loss in the second and third trimesters. Many pregnant women develop MD which may reverse after labour. In the case of MD diagnosed previously, may be exacerbated during the second and third trimesters.²⁶ MD is diagnosed based on Barany Society criteria such as two or more episodes of spontaneous vertigo for 20 minutes to 12 hours; low and mid-frequency sensorineural hearing loss recorded with pure tone audiometry in one ear, defining the affected ear, and at least one episode before, during or after one of the vertigo attacks; fluctuating auditory symptoms such as hearing loss, aural fullness and tinnitus; there is no other vestibular diagnosis which better explains the symptoms.²⁷

Vestibular migraine

The characteristic features of vestibular migraine (VM) are episodic vertigo, phonophobia, intolerance to light, auras, and headache.²⁸ Before pregnancy, many of them are diagnosed with migraine.²⁸ It can occur in any age group with a prevalence of 1.1 to 3.2%.²⁸ VM is more common in females compared to males with a ratio of 1.5:5.²⁸ The exact cause of VM is not clear and there are several theories proposed such as neurochemical, genetic, and inflammatory mechanisms, all are derived from the etiopathology of migraine.^{29,30} Up to 40% of pregnant women experience VM and the duration of vertigo may range from minutes to hours.³¹ Other than classical features of VM, the patient may complain of tinnitus in bilateral ears in comparison to nonpregnant females.²⁹ Videonystagmography often shows persistent positional

nystagmus or saccadic pursuits in case of long-standing VM.²⁸ Other features in VNG include reduced caloric response, increased contralateral preponderance, and raised vestibular unilateral deficits in 10 to 20% of the pregnant women.²⁸

Vestibular schwannoma

Vestibular schwannoma may be diagnosed during pregnancy and can rapidly increase its volume in that period. Approximately thirty cases of vestibular schwannoma were reported in the medical literature. It is unclear whether the rapid growth of the vestibular schwannoma during pregnancy might be due to the direct impact of hormones in a small part of the tumors or to an indirect effect of raised vascular supply. A study on estrogen receptors in sporadic vestibular tumors showed negative results.²⁸

Vestibular neuritis

Vestibular neuritis during pregnancy is often observed and it may be difficult for otolaryngologists and obstetricians to evaluate a pregnant woman and find out the appropriate treatment because of the drug contraindications. Pregnant women with vestibular neuritis usually present with vertigo, nausea, vomiting. She will not present any auditory complaints. There may be history of common cold few days/weeks before onset of symptoms.

Diagnosis

Early diagnosis of audiovestibular disorders is helpful to prevent the morbidity of the pregnant women during pregnancy. The diagnosis of the important audiovestibular disease like otosclerosis is made by proper clinical evaluation, pure tone audiometry, tympanometry and surgical confirmation.³² Some pregnant women show reduction of threshold on low frequencies resembling MD, attributed the mechanism of the reduced hearing to salt and water retention during pregnancy period, particularly in the third trimester.³³ Glycerol test, electrocochleography (ECoG), caloric test, eye-tracking test, auditory brain stem response (ABR), and computed tomography (CT) scan are the useful test to confirm the diagnosis of MD.

A diagnosis of posterior semicircular canal BPPV is confirmed by a transient, up beating, torsional nystagmus with eyes beating towards the underlying ear when the patient is rapidly positioned into a lateral hanging position (Dix-Hallpike test).³⁴ In case of labyrinthine hypofunction such as vestibular neuritis, spontaneous horizontal nystagmus with direction towards the unaffected side. She may fall to the affected side when eyes are closed. The pure tone audiogram in vestibular neuritis shows normal hearing of all frequencies. In vestibular neuritis, all biochemical parameters are within normal limit. The vestibular evoked myogenic potential

(VEMP) test reveals a prolonged P1-N1 latency (reduced vestibular function) on the affected side. The caloric test is often avoided during pregnancy as it may exacerbate the vertigo, so worsen the pregnancy. There are no confirmatory diagnostic tests are available for vestibular neuritis and the primary diagnosis of it is a diagnosis of exclusion. The diagnosis of vestibular neuritis is usually based on a constellation of bedside and laboratory findings. The diagnostic hallmarks of vestibular neuritis are spontaneous horizontal torsional nystagmus beating away from the side of the lesion, abnormal head impulse test for the affected semicircular canals, ipsilateral caloric hypofunction, reduced response of vestibular evoked myogenic potentials during stimulation of the affected ear, and unsteadiness with a falling tendency to the affected side.³⁵

Treatment

The treatment of audiovestibular manifestations is often challenging to the clinicians as there are many constraints to prescribe or intervene pregnant women in the safety of the fetus and mother. The treatment of the otosclerosis during pregnancy often done after delivery of the baby by stapedectomy or stapedotomy.¹⁰ If pregnant women face communication problem due to hearing loss, she can be fitted with hearing aid during pregnancy. Sodium fluoride should be avoided during pregnancy as it has harmful effects on body such as hamper bone absorption while increasing the calcification.³⁶ The sudden sensorineural hearing loss during pregnancy can be treated with administered of corticosteroids in the third trimester.³⁷ Intravenous dextran is a useful medication for sudden sensorineural hearing loss.

Dextran 40 is a type of colloid solution used as a plasma expander and it reduces blood viscosity and enhances the microcirculation which decrease the cochlear hypoxia.³⁸ The eustachian tube dysfunction in pregnant women is often treated by oral decongestants or topical nasal decongestants. The eustachian tube dysfunction is rarely treated by insertion of grommet insertion. The vestibular neuritis can be treated with administration of intravenous dexamethasone, vitamin B6, B12 complex and metoclopramide. In pregnancy, vestibular suppressant like diazepam is usually avoided because of its harmful effect on fetus. Corticosteroids in vestibular neuritis is useful to provide anti-inflammatory effect, rapidly and significantly decrease the nerve inflammation and enhances the recovery of the vestibular deficit.³⁹

Dexamethasone or betamethasone may be useful in pregnant women with risk of premature of birth to promote maturation of the lungs of fetus. First and few second-generation antihistamines can be prescribed in pregnancy if required as vestibular suppressants.⁴⁰ Antiemetics to combat nausea include meclizine, dimenhydrinate or metoclopramide. The most widely used medication in vertigo such as betahistine are contraindicated in pregnancy. Diazepam is a vestibular

suppressant prescribed by many otolaryngologists. However, diazepam is contraindicated in pregnancy if used for longer period or in high doses in pregnant women. Diazepam may cause floppy infant syndrome and benzodiazepine withdrawal syndrome.⁴¹ After medical treatment, the vestibular rehabilitation exercises should be done by the patient which ensure the complete recovery. Patient should perform a series of head exercises horizontally, gradually faster, as if expressing a 'no', keeping a fixed gaze on point ahead. When the maximum frequency of head movement is occurred, the patient stops and, ten seconds after, restart the procedure, that should be repeated ten times. Next, the series of vertical head movement should be done as if the patient express a 'yes' with the head. The Cawthorne-Cooksey exercises should be performed as a home protocol to the patient. These exercises or instrumental rehabilitation training consisting of standing with eyes open or closed on a moving platform, relative to the subjects, in anteroposterior or mediolateral direction, training sessions for both interventions are twice daily, thirty minutes per session, for one week.

CONCLUSION

Audiovestibular symptoms during pregnancy directly affects the pregnant mother both mentally and physically. Audiovestibular manifestations are commonly found in pregnancy, and most of them are treated conservatively as these disappear after delivery of the baby. So, avoidance of the unnecessary medications or interventions can reduce the risk to the fetus and mother. As the pregnancy progress, the audiovestibular manifestations disappear with total resolution in the postpartum period, which indicates that these symptoms are more physiological than pathological. Clinicians should keep in mind regarding the audiovestibular manifestations during pregnancy for betterment of fetus and mother. A multidisciplinary approach by otolaryngologists, neurologists, and gynaecologist and obstetricians is required for proper evaluation and management of audiovestibular manifestations in pregnant women.

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