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FETAL HEART RATE WITH HYPERTENSIVE AND NON-HYPERTENSIVE MOTHERS ON ULTRASONOGRAPHY IN THIRD TRIMESTER- A SYSTEMATIC REVIEW

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Abstract

Background: Preeclampsia throughout pregnancy increase a women's chance of developing cardiovascular disease. Women that develop preeclampsia are at higher risk for development of hypertension and cardiac disease.

Objective: To evaluate the relationship between maternal health (blood pressure} and fetal heart rate (FHR) during third trimester, and differentiate FHR in male and female fetuses.

Material & Methods: An electronic study including the articles of nearly a decade and half. The studies were added by means of Google Scholar, Research gate, NCBI and PubMed to name a few. All the articles were included in the official language English. Articles were included having sonographic relation between the hypertensive and non-hypertensive mothers with fetal heart rate.

Results: Analyzing the topic, 14 articles were added to determine the exact correlation between fetal cardiac output and hypertensive mothers. 25 articles were added in introduction and technique while 4 articles were included to link pre-eclamptic mothers with adolescent offspring regarding their growth and cardiac output.

Conclusion: Gestational hypertension has adverse effect on fetal heart rate and studies have proved the difference by comparing them with normotensive pregnancies.

Keywords: Fetal, Heart, Maternal, Blood pressure.

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1. Introduction

Hypertension is characterized by elevation of blood pressure at a persistent rate. This is a long-lasting condition in the coronary arteries of the body [1] and leads to numerous cardiac disorders [3] There are as such no symptoms of hypertension [2] There are two types of hypertensions differentiated on the basis of their causes. The first one is primary hypertension or essential hypertension that is observable in a person with the passage of time. Majority of population suffers from essential hypertension. The second one is secondary hypertension that develops slowly when compared with the primary one. Gestational hypertension is the high blood pressure levels occurring during pregnancy and occurs in 35% of women [4] while chronic hypertension is observed in 25% of women [5]. Even 27.5% of women undergo from de novo hypertension in their post -partum period [6]. Gestational hypertension makes it complicated for the women to deliver the baby. There can be a premature birth or the body weight can be reduced if the mother is hypertensive. The severe form of blood pressure in pregnancy leads to preeclampsia. In this case, there is damage to organs such as kidneys [7]. It leads to visual impairment, liver damage and increased protein levels in urine. It has been observed that pregnancy is extremely affected by the consumptions of toxins such as drugs and alcohol. But, it is revealed in the latest researches that even emotional or psychological conditions have an adverse effect on pregnancy and in particular, the heart rate of fetus. Increased level of socio-economic stress or hypertension is also said to be severely dangerous for obstetric health [8]. Preeclampsia further leads to the variability in heart rate (HRV) in mother, resulting in the abnormalities in the fetal heart rate (HR). [9] Recording the fetal heart rate (FHR) using ultrasonography is an important of routine antepartum and intrapartum care. Fluctuation of FHR is also normal; in early pregnancy, the FHR fluctuate constantly, but during third trimester it becomes more stable. In pregnancy complicated with pre-eclampsia but not in normotensive pregnancies, a link between maternal cardiac rates variability and FHR has been demonstrated. The blood pressure values in normotensive to hypotensive conditions are as follows normotensive: maternal 120 mmHg systolic blood pressure, 80 mmHg diastolic BP in the mother. The second case is pre-hypertensive: maternal systolic BP 120– 139 mmHg maternal diastolic BP 80–89 mmHg. Considering hypertensive condition, maternal systolic BP is $\geqslant$160 mmHg. Clinical history contains an analysis of hypertension. The last case is hypotensive: maternal systolic BP $\leqslant$90 mmHg. This hypotension is transient, as stated in the file of patient, and was accredited to the pregnancy. Hypertensive disorders during pregnancy are a major cause of death in both the mother and the fetus because their conditions are linked. During pregnancy, the heart rate of mother and her blood pressure is measured after intervals to determine the accurate cardiac health [10]. A clinical BPP is calculated by assigning 0 (absent) or 2 (present) points to each of the following real-time ultrasound scanning interpretations: three or more distinct body/limb motions, an occurrence of fetal breathing lasting 30 seconds, sharp extension or flexion of the limbs and trunks, and a pocket of amniotic fluid measuring at least 2 cm in two perpendicular planes. [11]. Adding on, it is observed that in a pregnant hypertensive woman, there is reduced response of heart rate in comparison to normotensive study. Parasympathetic Nervous System in pregnant woman is specifically assessed to determine the accuracy in the fetal heart rate while sympathetic nervous system is also considered an assessment tool. [12] The goal of this

research is to find out what health conditions of fetus and its relation with a hypertensive and a normotensive mother.

1.1 Materials and Methods

Search Strategy:

The data bases PubMed, Proquest, and Google scholar and Research gate were searched with the key words: Heart rate of the fetus, heart rate of the mother and hypertension, Hypertensive Mothers from 2010 to 2020. Only those studies were enrolled in the review which includes the Fetal Heart rate

Selection Criteria:

For inclusion and exclusion of studies independently screened the titles and abstracts of full-length related articles. The disparity of the reviewer was fixed by consensus. Studies having information of role of ultrasound in diagnosis of fetal heart rate in third trimester included. Data was extracted from full length journals and studies were asses for applicability and quality.

Study Characteristics:

Total 70 studies were found after searching data bases and 14 of them were excluded due to duplication. 28 studies were excluded due to irrelevant or insufficient data and 10 studies rejected on the basis of title and abstract. Flow chart summarizes the reviewed flow records in Figure 1. Only original research articles were included in this research excluding the systematic reviews and meta-analysis reviews. All the studies included in this review are prospective.

Data Synthesis and analysis Procedure:

The eligible studies were first categorized according to diagnose fetal heart rate in hypertensive mothers during third trimester.

2.Results & Discussion

In a study by Igor Victorovich Lakhno, The FHR in PE revealed an abnormally comparative increase of sympathetic domain area values in repressed autonomous nerve guidelines.

Fetal SDNN and TP levels were lower in Groups II and III. However, the parts of AMo, SI, and LF developed relatively in the entire fetal HRV spectrum in preeclampsia patients. In Group III, the discovered tendency was associated with nearly complete damage to the cardiac rhythm non-linearity. [13]

In a study by C. Ann Brown et.al, the maternal procedures underwent regression analysis, The BMI, amniotic fluid index, PNS indicator, SNS and SBR slope were included. The number of HR speeds and decelerations above 15 mpm, the number of body movements, the amount of fetal breathing, the extent of the peak HR acceleration (max HR) and deceleration (min HR), and the variance in HR (SDHR) over the recording period were all included in the fetal procedures. Maternal BMI was linked to the number of fetal HR accelerations greater than 15 bpm in the normotensive group (r2 14.34). None of the maternal HRV variables were associated with fetal HR measurements. Maternal BMI was related to the amount of fetal breathing (r2 14.30) and the quantity of fetal body actions (r2 14.28) in the hypertensive group). [14]

2400 cases were studied in a study by Sven Montan, MD, and Ingemar Ingemarsson. In hypertensive deliveries, dangerous intrapartum fetal heart rate configurations were significantly more common than in normotensive deliveries (20.5 percent versus 7.6 percent). Unpromising fetal heart rate forms were more common in hypertensive women who were not exposed to these risk factors, but the significant differences in comparison to normotensive women remained. Hypertensive pregnancies accounted for no less than 21.0 percent of all potentially dangerous intrapartum the fetal heart rate pattern could be attributed to the increased rate in hypertensive pregnancies in 13 percent of all potentially dangerous intrapartum fetal heart rate patterns. [15]

Kent L. Thornburg et al. completed their research and presented an automated model, the fundamentals of which could be validated in a future study. It proposes ecological, epigenetic, and genetic predispositions in mothers that influence placentation. The role of the placenta in the development of preeclampsia is unclear, but there is evidence

that a poorly perfused placenta, either due to insufficient vascularization or poor repair of the uterine circulation, indicates oxidative stress inside the placenta and in the tissues of the fetus. Furthermore, a disjointed umbilical microcirculation raises the impedance encountered by the developing heart. This extremely difficult condition is shared by babies whose intrauterine growth is restricted. [16]

In a study by Christina Y et al, Infants born to a hypertensive mother had a comparable left ventricular mass at birth, related with those born to mothers having normotensive pregnancies, with no variances in left ventricular mass indexed to surface area of body or EDV. LV EDV was minor but the variance was no longer important when accustomed for body size and, at the age of 3 months, no noteworthy variances in LV volume were cleared. However, LV mass indexed to whichever body size or ventricular volume was expressively amplified in the group born to a hypertensive mother at the age of 3 months. [17]

3.Conclusion

The systematic review concludes that gestational hypertension creates unfavorable changes in the cardiac output of fetus. Further studies also revealed that the adverse effects were not only limited to fetus but as an adolescent offspring as well. The heart rate was seriously disturbed. So, pregnant women must have precautionary measures and consultation with their gynecologist to avoid damage to the fetus.

Conflict of Interest

There is no conflict of interest in this research.

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Table 1. PRISMA Flow Diagram

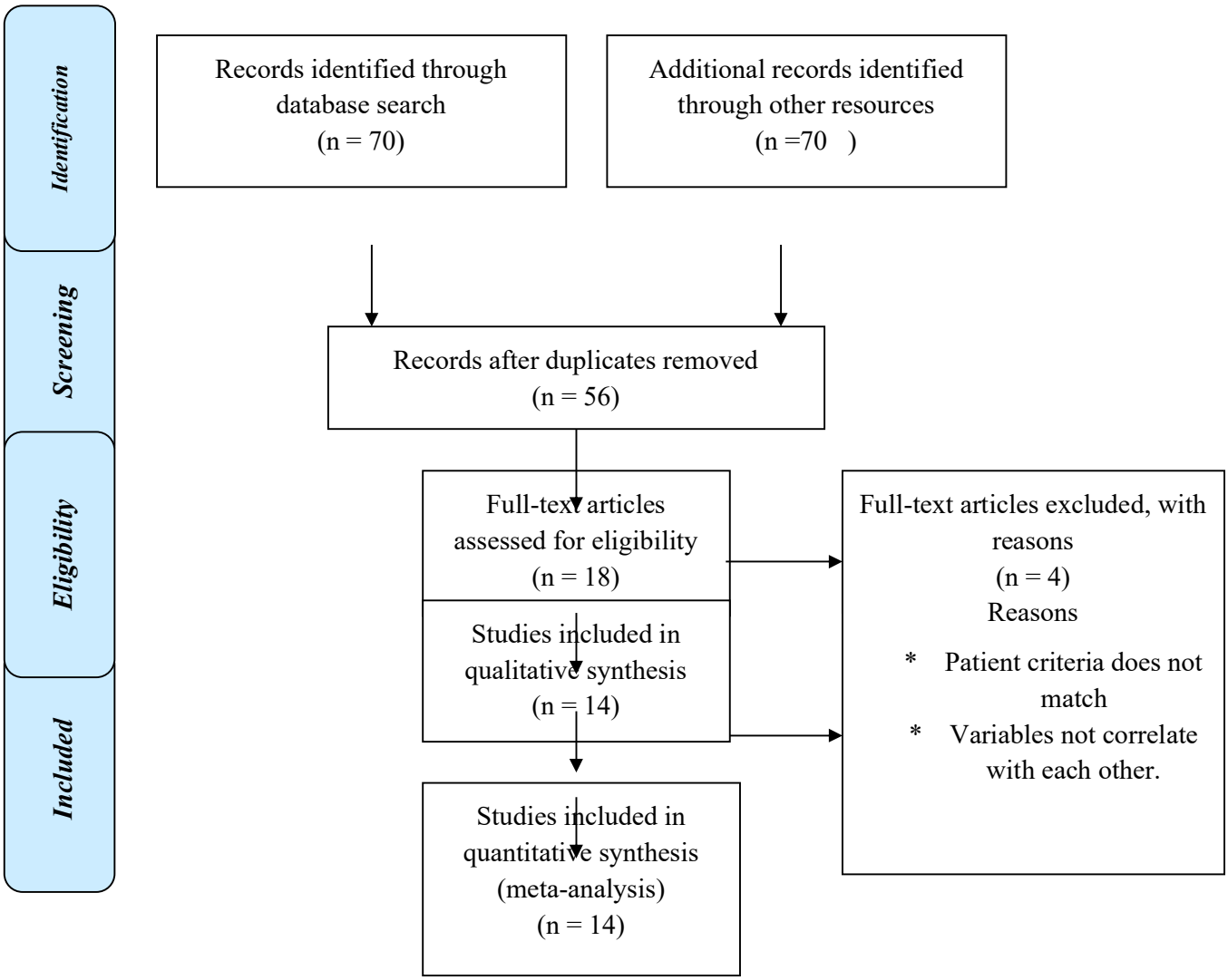

Table 2. Timeline Table

Sr. #	Author & Year	Journal	Sample size	Disease	Conclusion
1.	C Ann Brown et al 2008	SAGE journal	00	FHR	The hypertensive group's average body mass index (BMI) was higher (33.7 vs. 28.8 kg/m2). There was no association in the normotensive group between maternal HRV and fetal gestational age, HR, body or breathing.
2.	MoawiaGameraddin et al 2015	International Journal of Current Research	100	FHR	Maternal hypertension has a significant effect on FHR. The FHR did not differ significantly between diabetic and non-diabetic fetuses. The FHR did not differ significantly between male and female fetuses.
3.	Christina Y *et al 2020*	Journal of American Heart Association	134	FHR	Children born on hypertensive pregnancy have evidence of both prenatal and postnatal differences in cardiac development, with correct ventricular changes proportional to the severity of pregnancy disorder. Whether differences persist and their underlying cause and relationship to increased cardiovascular risk requires further study
4.	S Montan et al	American Journal of obstretics and gynecology	200	FHR	At no less than 22.0% of all ominous patterns of the intraparty fetal cardiac rate were due to hypertensive pregnancies; while 13% could be attributed to the excessive frequency in all cases of ominous fetal cardiac intrapartite patterns.
5.	Igor Lakhno et al 2014	Archives of Perinatal Medicine	94	FHR	Preeclampsia was associated with decreased fetal heart rate variability and all of its fractal components. Autonomic tone was significantly decreased in direct proportion to the severity of preeclampsia.
6.	Critian Ivan et al 2020	Heilyon	42	FHR	Short-term fetal fHRV is decreased, indicating decreased vagal modulation and an increase in the heart's adrenergic response. These autonomic changes may be a result of the fetal response to labor's

					stressful inflammatory challenge.
7.	Stephanie Braunthal et al 2019	SAGE	121	FHR	Despite the different guidelines, it seems to be agreed that severe high blood pressure and non-severe high blood pressure should be controlled, with evidence of organ damage; the ideal target ranges below 160/110 mmHg remains a subject of debate.
8.	Romy Gaillard et al 2011	American Journal of Hypertension	8623	FHR	Lower second and third trimester systolic blood pressure is associated with older maternal age, but higher third trimester diastolic blood pressure. These blood pressure variations appear to be minor and within the physiological range. The risk of gestational hypertensive disorders is not consistently associated with maternal age. The relationship between maternal age and the risk of pregnancy-induced hypertension may be influenced by maternal BMI.
9.	LjiljanaMirkovic et al 2020	ELSEVIER	89	FHR	In women with high BP have fetal cardiac anomalies.
10.	Simon Timpka et al 2016	The American Journal of Heart Association	541	FHR	Adolescent offspring of mothers who had preeclampsia had greater relative wall thickness and lower left ventricular end-diastolic volume, which could be early signs of concentric remodeling and affect future cardiac function as well as risk of cardiovascular disease.
11.	Fabio Angeli et al 2014	Hypertension Research	76	FHR	When hypertension disorders are diagnosed during pregnancy, the maternal risk of placental abruption, organ failure, cerebrovascular accident, and disseminated intravascular coagulation increases, as does the fetal risk of intrauterine growth restriction, intrauterine death, and prematurity.

12.	Pierre-Yves Jayetet al 2010	Circulation	48	FHR	The systemic and pulmonary circulation of the offspring leaves a persisting defect in Preeclampsia. This predispose already during childhood to exaggerated hypoxic pulmonary hypertension, which can lead to premature cardiovascular disease in systemic circulation later in life.
13.	Esther Frances Davis et al 2012	Pediatrics	18	FHR	Young offspring of preeclampsia-complicated pregnancies already have elevated blood pressure and body mass index, a finding that may require consideration in future primary prevention strategies for cardiovascular disease.
14.	Kent L Thromburg et al 2020	Journal of American Heart Association	134	FHR	Hypertensive pregnancy disorders include high blood pressure, end organ pathology and serious disease including stroke or seizures. 9 A subset of women with GH acquires organ-specific pathological characteristics that define preeclampsia.

Table No 3:

Index	Group I	Group II	Group III
SDNN, ms	45.8±13.1	29.4±8.3*	10.2±4.5*†
RMSSD, ms	22.4±3.4	14.2±2.6*	8.1±0.8*†
pNN5O, %	4.2±1.1	2.0±0.4*	1.1±0.3*†
AMo, %	39.6±14.1	50.2±11.6*	65.9±13.4*/†
SI, c.u.	169.3±42.7	496.1±65.8*	1467.3 ± 405.8*/†
TP, ms^2	1513.6±329.1	896.2±163.5*	424.9±93.7*†
VLF, ms^2	1252.8±248.3	692.8±91.3*	251.8±44.2*†
LF, ms^2	184.3±26.5	151.9±34.1*	135.0±19.6*†
HF, ms^2	77.6±9.4	53.6±8.2*	38.9±10.4*†

Table No 4:

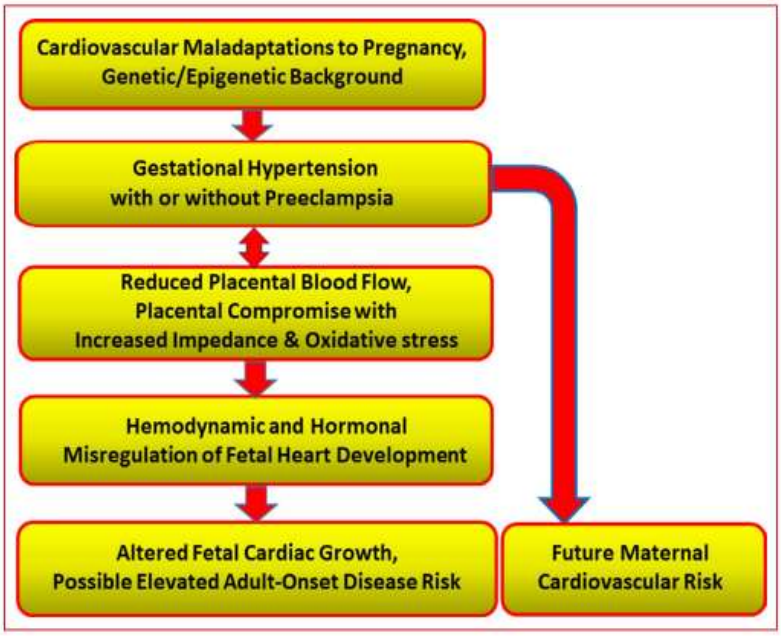

Figure No 1 At 27 weeks of pregnancy, two-dimensional apical 4-chamber image in a pregnant control (A) and a white patient with preeclampsia aged 30 years (B). At the time of the assessment, the case and control groups were matched for ethnicity, maternal age, and gestational age. The left ventricle (LV) concentric remodelling and modest pericardial effusion (yellow arrow) in the preeclampsia patient (B) may be seen compared to a normal LV geometry in the control (A).

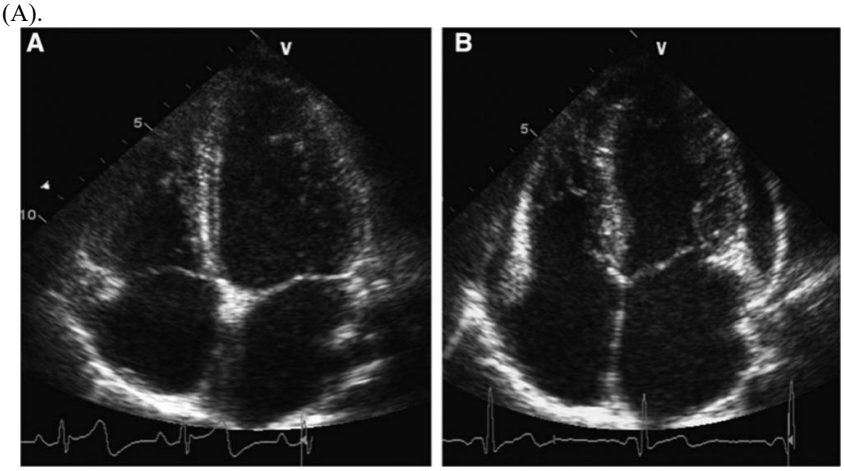

Figure No 2: A comprehensive fetal echocardiography is also recommended to confirm the rate and rhythm of the tachycardia, confirm normal cardiac architecture, and examine any hemodynamic repercussions of the heartbeat. M-mode and pulsed Doppler, in addition to normal two-dimensional imaging and color flow mapping, are crucial for fetal arrhythmia characterization.