ASSESSMENT OF DIASTOLIC FUNCTION OF RIGHT AND LEFT VENTRICLES IN INFANTS OF DIABETIC MOTHERS WITH RESPIRATORY DISTRESS SYNDROME

By

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ABSTRACT

***Background**: The present study was a Descriptive case-control study done that included infants of diabetic mothers with respiratory distress syndrome and infants of diabetic mothers without respiratory distress syndrome. Healthy full-term neonates were also included as a control.*

Infants of diabetic mothers are frequently suffered from several cardiac and respiratory complications.

Cardiovascular compromise is a common complication of neonatal respiratory distress syndrome (RDS).

Our study assessed the diastolic function in infants of diabetic mothers with RDS and report that they are more likely to develop increase diastolic dysfunction than infants of non-diabetic mothers.

***Aim**: The purpose of this study was to assess the diastolic function of right and left ventricles using Conventional Doppler and Tissue Doppler Imaging (TDI) in infants of diabetic mothers with RDS and infants of diabetic mothers without RDS.*

***Methods:** The study was conducted in neonatal intensive care unit (NICU) in Bab-Alsheria hospital, Pediatric department, Faculty of medicine, Al-Azhar University, cairo, in the period from June 2018 to February 2019 . The present work was conducted on forty neonates IDM (20 with RDS, 20 without RDS) and 20 (control), the degree of RDS was clinically scored by Downes' score All have: Detailed history-clinical examination-Plain X-ray- Tissue Doppler Imaging (TDI) and Doppler echocardiographic .*

***Results:** Show significant higher value in IVS, Mitral A wave velocity and Tricuspid A wave velocity in IDMs with RDS compared to IDMs without RDS and control group. And significant lower values in Mitral E-wave velocity, Mitral E/A ratio, Tricuspid E-wave velocity, and Tricuspid E/A ratio in IDMs with RDS compared to IDMs without*

RDS and control group . Tissue Doppler Imaging (TDI) shows both the left and right ventricle myocardial velocities were found to be lower in the infant of diabetic mothers with RDS compared to the control group.

Conclusion: *Infants of diabetic mothers with RDS are more prone to diastolic dysfunction and increase myocardial thickness compared with AGA- infants of diabetic mothers without RDS and control group.*

Key Words: *Echocardiogram, Infants of diabetic mothers (IDM), Respiratory distress syndrome (RDS).*

INTRODUCTION

Diabetes mellitus is increasing in incidence in the general population leading to growing number of pregnancies complicated by this condition **(Katheria & Leone, 2012)**.

Diabetes in pregnant women could be either pregestational or gestational. Gestational diabetes accounts for about 80% of cases and could represent a predisposition to type 2 diabetes mellitus or an extreme manifestation of metabolic changes during pregnancy **(Opara et al, 2010)**. Gestational diabetes is defined as glucose intolerance with onset or first recognized during pregnancy **(Lindsay, 2002)**.

Echocardiography allows a direct assessment of the direction of blood flow across fetal channels, namely the foramen ovale (FO) and the patent ductus arteroisus (PDA), which is an indicator of the degree to which the pulmonary resistance has fallen after birth **(Katheria & Leone, 2012)**.

Cardiac malformations in IDMs are five times higher than in normal pregnancies. Ventricular or atrial septal defect, transposition of great vessels, truncus arteriosus, double outlet right ventricle, and coarctation of aorta are most common **(Wren et al, 2003)**.

It is believed that anabolic results of fetal hyperinsulinemia triggered by maternal hyperglycemia during the third trimester can cause hypertrophic cardiomyopathy (HCM) with asymmetric septum enlargement in 30% of IDMs **(Potter & Kicklighter, 2006)**.

Fetal hyperinsulinism may trigger hyperplasia and hypertrophy of myocardial cells by increasing fat and protein synthesis **(Mehta & Hussain, 2003)**.

Respiratory distress is a common emergency responsible for 30–40% of admission in the neonatal period .Respiratory

Distress Syndrome (RDS) is one of the most important diseases affecting neonates, especially premature infants, and is considered as the most common cause of respiratory failure and death in this age group **(Wax et al., 2009)**.

RDS is a condition of pulmonary insufficiency that in its natural course commences at or shortly after birth and increases in severity over the first 2 days of life. Clinically, RDS presents with early respiratory distress comprising cyanosis, grunting, retractions and tachypnea. Respiratory failure may develop, indicated by blood gas analysis, and the diagnosis can be confirmed on chest X-ray with a classical 'ground glass' appearance and air bronchograms .If left untreated death may occur from progressive hypoxia and respiratory failure. In survivors, resolution begins between 2 and 4 days. RDS is due to a deficiency of alveolar surfactant along with structural immaturity of the lung and it is mainly, but not exclusively, a disease of preterm babies **(Dunn et al., 2011)**.

The diastolic dysfunction represents the earliest manifestation of diabetic cardiomyopathy, preceding the systolic dysfunction and being able to progress to symptomatic heart failure **(Fouda et al, 2013)**.

There is an increased myocardial mass because of high levels of insulin in infant of diabetic mothers and this may lead to dysfunction in diastole. Most infants of diabetic mothers may be asymptomatic despite this dysfunction **(Cimen & Karaaslan, 2013).**

These transient disturbances in the immediate postnatal adaptation of pulmonary circulation may be related to delayed pulmonary maturation, myocardial hypertrophy and hypoglycemia in IDMs. Changes in myocardial compliance that cause an altered pattern of diastolic filling, with an elevation in intraventricular pressure, which is retrogradely transmitted to the left atrium and pulmonary circulation **(Vela-Huerta et al, 2007)**.

AIM OF THE WORK

The purpose of this study was to assess the diastolic function of right and left ventricles using conventional Doppler and Tissue Doppler Imaging (TDI) in infants of diabetic mothers with respiratory distress syndrome in comparison with neonates of diabetic mothers without respiratory distress syndrome and healthy full-term neonates as control.

Ethical Considerations:

1. A written informed consent was obtained from patients or their legal guardians.
2. Approval of the ethical committee in Pediatrics department and Al-Azhar faculty of medicine was obtained before the study.
3. The data of the patients and the results of the study are confidential and the patients had the right to keep.
4. The patient had the right to withdraw from the study at any time.

5. The authors received no financial support for the research, authorship, and/or publication of this study.

PATIENT AND METHODS

The study was conducted in neonatal intensive care unit (NICU) in Bab-Alsheria hospital, Pediatric department, Faculty of medicine, Al-Azhar University, cairo, in the period from June 2018 to February 2019. The present work was conducted on forty neonates IDMs (20 with RDS, 20 without RDS) and 20 (control), the degree of RDS was clinically scored by Downes' score All have: Detailed history-clinical examination-Plain X-ray-Tissue Doppler Imaging (TDI) and Doppler echocardiography.

The study population was classified into 3 groups as follows:

Group A: 20 healthy full-term infants as age and sex matching controls.

Group B: 20 consecutive appropriate for gestational age infants of diabetic mothers without RDS.

Group C: 20 consecutive infants of diabetic mothers with respiratory distress syndrome.

Inclusion Criteria:

- Neonates with RDS with known diagnosis of maternal type 1 or type 2 diabetes or gestational diabetes (GD) treated with diet alone or associated with oral hypoglycemic drugs and/or transient insulin therapy.
- Age and sex matching healthy full-term neonates.

Exclusion Criteria:

- Severe prematurity AND/OR Extreme low birth weight (ELBW) neonate
- Maternal history of preeclampsia.

Methods:

All groups were subjected to the following:

1. Full perinatal history taking:

- Antenatal data: includes antenatal care, infection, drugs intake and exposure to radiation
- Maternal disease: includes type and management of diabetes, HbA1C level, and heart disease
- Perinatal data: includes Gestational age, PROM, Fetal distress, Meconium aspiration, asphaxia, multiple gestation, placental position, antepartum hge, abnormal presentation, mode of delivery, apgar score and sepsis.

2. Full clinical examination

- Birth weight: The included neonates were classified according to their birth weight in relation to gestational age:

i. Small for gestational age (SGA) neonates with birth weight <2 standard deviation (SD) below the mean for gestational age or <10th percentile

ii. Appropriate for gestational age (AGA) neonates with birth weight between the 10th and 90th percentiles.

iii. Large for gestational age (LGA) neonates with birth weight >2 SD above the mean for gestational age or >90th percentile.

- Vital signs: including heart rate, respiratory rate and blood pressure
- Full Cardiac examination
- Examination of other systems: Abdominal, Chest and CNS examination

3. Laboratory investigation:

- Blood glucose level in the first day of life.
- Liver & kidney function whenever indicated.
- Complete blood count (CBC).
- Blood gases whenever indicated.

4. Radiological investigation:

- Chest and heart x-ray; to asses cardiothoracic ratio, specific chamber enlargement and pulmonary vasculature.
- Cranial ultrasound whenever indicated to document brain edema and intracranial hemorrhage.
- Abdominal ultrasound whenever indicated (to asses renal echogenicity).

5. Echocardiography:

- Echo-Doppler examination will be performed for all cases using a (GE® Vivid e) cardiovascular ultrasound machine with 4-8 MHz electronic sector transducer.
- The examination will be performed by pediatric cardiologist having experience in echocardiography .The examination will consist of pulsed, continuous wave Doppler blood flow velocity measurements of the heart valves and TDI.
- Pulsed wave (PW) Doppler will be used for each cardiac valve separately: for the mitral and tricuspid valves using apical four-chamber view. The following Doppler parameters will be measured: peak E wave velocity and peak A wave velocity for the mitral and tricuspid valves and E/A ratio.
- TDI velocities were measured at the mitral valve (MV) annulus, basal interventricular septum (IVS), and tricuspid valve (TV)annulus TDI was performed in the apical four-chamber view by placing a sample volume at three different sites: (1) Lateral border of mitral valve annulus (Left Ventricle); (2) Interventricular Septum (IVS) and (3) Lateral border of tricuspid annulus (Right Ventricle). The peak systolic and diastolic velocities at the LV, RV and IVS were assessed with TDI in cases and controls. The following parameters were recorded: systolic velocity (S`), early diastolic velocity (E`), late diastolic velocity (A`) and time intervals; isovolumetric relaxation time (IVRT)at each site. The IVRT was measured from the end of the S' wave to the onset of the E' wave.

Statistical Analysis:

All collected data were tabulated, coded and then analyzed and statistically described in terms of range, mean standard deviation (SD), median, frequencies (number of cases) and relative frequencies (percentages) when appropriate.

The confidence interval was set to 95% and the margin of error accepted was set to 5%.

So, the p-value was considered significant as the following:

- $P > 0.05$: Non-significant.
- $P \leq 0.05$: Significant

RESULTS

Our results were demonstrated in the following tables:

Table (1): Demographic data of the studied groups

<table>
<tr><th colspan="2"></th><th colspan="2">IDMs with RDS (n=20)</th><th colspan="2">Control group (n=20)</th><th>P-value</th></tr>
<tr><td colspan="2">Gestational age (wk)
Mean ± SD</td><td colspan="2">36.80 ± 0.894</td><td colspan="2">37.45 ± 0.51</td><td>0.008</td></tr>
<tr><td colspan="2">Birth weight (gm)
Mean ± SD</td><td colspan="2">3975 ± 132.29</td><td colspan="2">3070 ± 117.43</td><td><0.0001</td></tr>
<tr><td rowspan="2">Mode of delivery</td><td>Normal vaginal</td><td>0</td><td>0%</td><td>15</td><td>75%</td><td rowspan="2"><0.0001</td></tr>
<tr><td>Cesarean section</td><td>20</td><td>100%</td><td>5</td><td>25</td></tr>
<tr><td colspan="2">APGAR score
Mean ± SD</td><td colspan="2">7.700 ± 0.73</td><td colspan="2">9.35 ± 0.48</td><td><0.0001</td></tr>
<tr><td colspan="2">Diabetic control (Hb A1C)
Mean ± SD</td><td colspan="2">7.400 ± 1.31</td><td colspan="2">3.300 ± 0.57</td><td><0.0001</td></tr>
</table>

Table (1) shows statistically significant difference between IDMs with RDS and control group regarding Demographic data.

Table (2): Comparison among the studied groups regarding clinical findings

vital data		IDMs with RDS (n=20)		Control group (n=20)		P-value
HR (/min) Mean ± SD		142.5±4.2		132.85±3.11		**p<0.0001**
Systolic BP Mean ± SD		60.65±1.49		66.10±1.86		**p<0.0001**
Diastolic BP Mean ± SD		45.45±1.53		45.75±1.65		0.556
Murmur	**No**	5	25%	20	100%	**<0.0001**
	Yes	15	75%	0	0%	
Second heart sound (S2)	**Normal**	14	70%	20	100%	**0.005**
	Accentuated	6	30%	0	0%	
Downes' score Mean ± SD		5.55±1.05		2.45±0.5		**<0.0001**

Table (2) shows that there were statistically significant difference between the groups as regards heart rate, systolic blood pressure, murmur, second heart sound and Downes' score.

Table (3): Comparison among the studied groups as regards important laboratory results on admission

Lab on Admission	IDMs with RDS (n=20)	Control (n=20)	P-value
RBS (mg/dl) Mean ± SD	52.4±4.68	93.30±2.43	**<0.0001**
HB (gm %) Mean ± SD	17.30±0.86	15.75±0.63	**<0.0001**

Table (3) shows significant difference among groups regarding lower RBS, and higher hemoglobin levels in IDM with RDS compared to control.

Table (4): Comparison among the studied groups regarding respiratory Support

Respiratory Support	IDMs with RDS (n=20)		Control (n=20)		P-value
	%	N	%	N	<0.0001
NO	0%	0	100%	20	
NASAL	20%	4	0%	0	
CPAP	55%	11	0%	0	
VENT	25%	5	0%	0	

Table (4) shows statistically significant (p<0.0001) among the studied groups regarding respiratory Support.

Table (5): Comparison among the studied groups regarding chest x-ray findings

Chest x-ray on admission	IDMs with RDS (n=20)		Control group (n=20)		P-value
	%	N	%	N	
Free	0%	0	90%	18	<0.0001
Increased C/T ratio	0%	0	10%	2	
Increase C/T ratio with ground glass appearance	45%	9	0%	0	
Increased C/T ratio with white lung	25%	5	0%	0	
Ground glass appearance	30%	6	0%	0	

C/T ratio: cardiothoracic ratio

Table (5) shows statistically significant difference (p<0.0001) amongs the studied groups as regard chest X- ray findings.

Table (6): Comparison among the studied groups as regard the echocardiographic parameters

Echocardio-graphy	IDMs with RDS (n=20)	Control (n=20)	P-value
	Mean±SD	Mean±SD	
IVS (mm)	5.90±.07	3.77±0.03	**< 0.0001**
Mitral E (cm/sec)	63.95±10.4	76.35±9.05	**< 0.0001**
Mitral A (cm/sec)	76.55±13.3	60.50±7.08	**< 0.0001**
Mitral E/A	0.84±0.14	1.26±0.08	**< 0.0001**
Tricuspid E(cm/sec)	48.30±6.11	56.25±5.17	**< 0.002**
Tricuspid A (cm/sec)	58.50±7.50	53.15±7.07	**0.026**
Tricuspid E/A	0.83±0.12	1.02±0.09	**<0.0001**

Table (6) shows significant higher value in, IVS, Mitral A wave velocity and Tricuspid A wave velocity in IDMs with RDS compared to control group. And significant lower values in Mitral E-wave velocity, Mitral E/A ratio, Tricuspid E-wave velocity, and Tricuspid E/A ratio in IDMs with RDS compared to control group.

Table (7): Comparison among the studied groups regarding Z- score of the interventricular septum thickness

Z Score	IDMs with RD (n=20)	Control group (n=20)	P-value
	Mean ± SD	Mean ± SD	
Z Score	2.05 ± 0.69	0.38 ± 0.44	**<0.0001**

Table (7) shows statistically significant difference among the studied groups regarding Z- score of the interventricular septum thickness.

Table (8): Comparison among the studied groups as regard the echocardiographic parameters

TDI (Lateral Mitral Annulus)

Echocardiography	IDMs with RDS (n=20)	Control (n=20)	p-value
	Mean±SD	Mean±SD	
LV E' (cm/s)	6.40±1.95	7.30±1.80	**.139**
LV A' (cm/s)	6.50±1.46	5.20±1.19	**.004**
LV S' (cm/s)	4.80±1.43	4.90±.71	**.782**
LV E / E'	7.97±1.77	9.44±3.37	**.09**
IVRT LV ms	46.85±13.19	35.19±12.53	**.006**

Table (8) shows statistically significant difference among the studied groups as regard mitral LV A' (p-value 0.004) and IVRT (p-value 0.006), while other parameters show statistically insignificant.

Table (9): Comparison among the studied groups as regard the echocardiographic parameters

TDI (Interventricular Septum)

Echocardiography	IDMs with RDS (n=20)	Control (n=20)	p-value
	Mean±SD	Mean±SD	
Septal E' (cm/s)	5.10±.8	5.40±1.50	**.585**
Septal A' (cm/s)	5.60±1.23	5.80±1.05	**.457**
Septal S' (cm/s)	3.90±1.07	4.25±0.6	**.044**
Septal E / E'	9.58±1.36	12.24±4.62	**.003**
IVRT septal ms	52.16±13.83	42.37±10.18	**.023**

Table (9) shows statistically significant difference among the studied groups as regard septal E / E'(p-value .003), septal S' (p-value 0.04) and IVRT (p-value .023) while other parameters show statistically insignificant.

Table (10): Comparison among the studied groups as regard the echocardiographic parameters

TDI (Lateral Tricuspid Annulus)

Echocardiography	**IDMs with RDS (n=20)**	**Control (n=20)**	**p-value**
	Mean±SD	**Mean±SD**	
RV E' (cm/s)	6.80±1.7	8.10±.96	**.005**
RV A' (cm/s)	8.90±2.02	8.35±1.69	**.357**
RV S' (cm/s)	5.90±1.68	5.45±0.82	**.290**
RV E / E'	5.89±1.57	5.11±.789	**.061**
IVRT RV ms	50.29±10.79	39.02±7.23	**.000**

Table (10) shows statistically significant among the studied groups regarding RV E' (p-value .005) and IVRT (p-value .000) while other parameters show statistically insignificant.

DISCUSSION

The fetal heart is a target organ for the congenital effects of pre-gestational as well as gestational maternal diabetes. It significantly affects the fetal heart and fetal–placental circulation in both functions and structures; causing cardiac anomalies and myocardial hypertrophy **(Gardiner et al, 2006)**.

The cardiovascular complications were usually attributed to poor control of hyperglycemia during pregnancy **(Nili & Mahdaviani, 2004)**.

The purpose of this study was to assess the diastolic function of right and left ventricles using Conventional Doppler and TDI in infants of diabetic mothers with RDS and infants of diabetic mothers without RD.

The studied sample was well matched as regards sex distribution and gestational age.

In the present study all neonates whether IDMs with RDS were delivered by cesarean section compared to (25%) in control group. This is in agreement with **(katheria & leone, 2012)** who reported Cesarean section delivery, was more frequent in the IDMs than control.

In comparing the mean random blood glucose level in IDM and control, the current study reported that the mean random blood sugar in IDMs was significantly lower than that in control group.

The current study reported that the mean random blood glucose was significantly lower in IDMs with RDS and increase birth weight compared to birth weight of control group. **(Ramos et al, 2012)** demonstrated that there is an association between degree of hypoglycemia and birth weight.

The same was reported by **(Rodopeyma et al, 2013)** as they found that there was a significant difference between the rate of hypoglycemia in LGA and hypoglycemia in non-LGA infants.

As regards association between control of diabetes and birth weight the current study found that there were statistical significant association between control of diabetes mellitus (in terms of HbA1C) and incidence of IDMs with RDS.

This matches with **(Al-Biltagi et al, 2015)** who showed significant positive correlation between neonatal birth weight and maternal HbA1c value.

The same was reported by (**Damm et al, 2014)** who found that, elevated HbA1c, high glucose spikes, were significant predictors for poor pregnancy outcomes especially macrosomia ($p<0.05$).

Also in agreement with **(El Ganzoury et al, 2012)** who reported that all LGA neonates were born to mothers with suboptimally controlled diabetes while 88.0% of AGA neonates were born to mothers with optimal metabolic control.

The study of **(Meur & Mann, 2007)** stated that neonatal birth weight correlates with glycosylated haemoglobin (HbA1c) values during pregnancy, they attributed this to hyperinsulinaemia, which has a strong anabolic effect.

In comparison between IDMs and Control group this study reported a significantly increased cardiac dimension (IVS). There was also impaired diastolic function in the form of higher value of Tricuspid A-wave velocity, Tricuspid E/A ratio, Mitral A-wave velocity, and Mitral E/A ratio in IDMs compared to control group.

These transient disturbances in the immediate postnatal adaptation of pulmonary circulation may be related to myocardial hypertrophy and hypoglycemia in IDMs **(Vela-Huerta et al, 2007)**.

This was in agreement with **(Al-Biltagi et al, 2015)** who found that there were a significant deterioration of diastolic functions measured by conventional echocardiography in IDMs compared with the control group..

Also **(korra et al, 2012)** found that there was significant increase in interventricular septal dimensions in infants of diabetic mothers in comparison to control and these match with this study.

(Fouda et al, 2013) found that the interventricular septum was significantly thicker in the IDMs compared with the control group. The same was reported by **(Demiroren et al, 2005)** who found that the mean IVS thickness values in IDM was statistically greater than control group.

It has been reported that the anabolic, hyperinsulinemic fetal state triggered by maternal hyperglycemia leads to hyperplasia and hypertrophy of myocardial cells by increasing fat and protein synthesis **(Mehta & Hussain, 2003)**.

Also, **(Barany et al, 2004)** related these findings to the effects of maternal hyperglycemia during the third trimester and subsequent fetal hyperinsulinemia leading to neonatal cardiac hypertrophy.

The diastolic dysfunction may be attributed to decrease in ventricular relaxation and compliance, as a consequence of myocardial hypertrophy **(Fouda et al, 2013)**.

Assessment of echocardiographic parameter, this study showed that there was significant increased IVS thickness IDM with RDS compared to IDM without RD.

These findings were similar to the study by **(El-Ganzoury et al, 2012)** who reported that there were significant progressive increases in IVS with the increase in birth weight.

Also, **(Tugertimur et al, 2000)** found that IVS thickness in LGA group was higher than that of AGA.

This finding may be attributed to hyperinsulinemia that induces smooth-muscle cell hypertrophy and hyperplasia and increased extracellular proteins which are an important factor contributing to increase birth weight and at the same time affects the cardiac structure and function **(Nigro et al, 2006).**

(Vela-Huerta et al, 2007) reported septal hypertrophy was significantly higher in LGA-IDMs.

The IVS thickness was higher in poor control LGA-IDM compared with good control LGA-IDM. Also in this study there was a statistically significant strong correlation between increased HbA1c level and increased IVS thickness in LGA-IDM.

Also, **(Fouda et al, 2013)** found a correlation between septal hypertrophy and the degree of diabetes control as they reported that mean HbA1c % were significantly higher in fetuses with septal hypertrophy attributing this finding to its rich content of insulin receptors..

While on the contrary **(Aman et al, 2011)** and Vela-Huerta et al, 2000 reported no correlation between HbA1c level and the presence of septal hypertrophy.

CONCLUSION

In view of the current study, we concluded that:

- Infants of diabetic mothers are at higher risk to increased myocardial thickness than infants of non-diabetic mothers.
- IDMs with RDS are more prone diastolic dysfunction compared with infants of non-diabetic mothers.
- All macrosomic infants IDMs are at higher risk for development of cardiovascular complications.
- Maternal glycemic control has a significant influence on cardiac morphology and function in IDMs.

RECOMMENDATIONS

- Proper antenatal care and proper control of diabetes during pregnancy by evaluation of HbA1c.
- Routine echocardiography should be done in all infant of diabetic mothers.
- Early and through cardiovascular evaluation as well as imaging studies and echocardiographic examination for early detection of myocardial dysfunction is essential in all premature neonates presented by RDS.
- Echocardiography should be done in all cases with

respiratory distress even those without audible murmur, especially so if not improving with proper intervention.

- NIPPV should have the priority in the management of cases of RDS and avoid MV as possible.
- Future studies are recommended including a large number of cases with RDS and multicenter studies to confirm our results.

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تقييم وظيفة القلب الإنبساطية للبطين الأيمن والأيسر لحديثى الولادة المصابين بصعوبة التنفس لدى الأمهات المصابه بداء السكرى

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الصعوبة فى التنفس من أهم الأعراض فى الأطفال حديثى الولادة . و من أهم أسبابها متلازمة صعوبة التنفس.

يعتبر الأطفال حديثى الولاده لأمهات مريضات بالسكر هم الأكثر عرضة لعيوب القلب الخلقيه عن غيرهم.

تكون تلك العيوب في صورة زيادة سمك عضله القلب و كذلك الجدار الفاصل بين البطينين و ضعف عضله القلب.

تبدأ ظهور العيوب الخلقيه في القلب لدى هؤلاء الأطفال أثناء فتره الحمل ، نتيجه لتعرض الجنين إلى ارتفاع نسبه السكر في دم الأم الذى يصل إلى الجنين، و من ثم يبدأ جسم الجنين في إفراز الأنسولين بنسبه عاليه.

يعتبر ارتفاع نسبه الأنسولين عند الجنين هو المسئول الرئيسي عن حدوث تلك العيوب الخلقيه بالقلب التي يعاني منها الطفل بعد الولاده.

جهـــاز الموجـــات فـــوق الصـــوتية علـــى القلـــب هـــو وســـيلة غيـــر تداخليـــة تســـاعد علـــى التشـــخيص وتقـــدير مـــدى تطـــور الحـــالات فى الأطفال حديثى الولادة واللذين يعانون من صعوبة بالتنفس.

- أقيمـــت هـــذه الدراســـة علـــى عشـــرين طفـــل حـــديثى الـــولادة مصـــابين بمتلازمـــــة صـــــعوبة التـــــنفس لأمهـــــات مصـــــابه بـــــداء الســـــكرى وعشـــرين طفـــل حـــديثى الـــولاده لأمهـــات مصـــابه بـــداء الســـكرى بوحـــــدات الرعايـــــة المركـــــزة لحـــــديثى الـــــولاده بمستشـــــفى بـــــاب الشـــعرية الجـــامعى-جامعـــة الأزهـــر-القـــاهره ، فـــى الفتـــره مـــن شـــهر يونيـــه 2018 حتـــى شـــهر فبرايـــر 2019 ، وعشـــرين طفـــل حـــديثى الولاده لأمهات أصحاء للمقارنه بهم.
- الهـــدف مـــن الدراســـة هـــو تقيـــيم وظيفـــة القلـــب الانبســـاطيه للبطـــين الأيمـــن والأيســـر لحـــديثى الـــولاده المصـــابين بمتلازمـــة صـــعوبة التنفس لأمهات مصابه بداء السكرى.
- تـــم عمـــل معامـــل تحليليـــة وأشـــعات ســـينية لهـــم وموجـــات صـــوتية علـــى القلـــب لكـــل الحـــالات كوســـيلة غيـــر تداخليـــة لتقـــدير مـــدى تأثر وظائف القلب الإنبساطية بدرجة الصعوبة فى التنفس.
- أهميـــة الموجـــات الصـــوتية علـــى القلـــب فـــى تشـــخيص وتحديـــد تطـــور الحـــالات التـــى تعـــانى مـــن صـــعوبة بـــالتنفس وعلـــى جهـــاز تنفس صناعى.

أهم النتائج التطبيقية التى تم التوصل اليها:

- الصعوبة بالتنفس من أهم وأخطر الأسباب التى تستدعى وضع الأطفال حديثى الولادة فى وحدات الرعاية المركزة.

- أهمية الموجات الصوتية على القلب كوسيلة آمنة وغير تداخلية لفحص الأطفال حديثى الولادة الذين يعانون من صعوبة بالتنفس.

- حديثى الولاده لأمهات مريضات بالسكر يعانون من زيادة في سمك عضله القلب و ضعف فى عضله القلب أكثر من نظائرهم لأمهات غير مريضات بالسكر.

- حديثى الولاده لأمهات مريضات بالسكر ممن يعانون من زيادة بالوزن هم أكثر إصابة بزيادة في سمك عضله القلب و ضعف عضله القلب عن نظائرهم ممن لا يعانون من زياده بالوزن.

- يوجد ارتباط بين نسبه السكر أثناء الحمل و زيادة وزن الطفل و من ثم الإصابه بعيوب القلب الخلقيه و زياده في سمك عضله القلب.