Echo and Abdominal Ultrasound Findings among Type 1 DM (T1DM) Adolescent in Correlation with HBA1C Level and Duration of Diabetes

Mohammad Ahmad Awwad Alqahtani, MD* Abdullah Othman, MD** Mohammed Ghathradi, MD***
Safar Al-Shahrani, MD**** Maali Melha, MD***** Sahar Al-Shehri, MD******

Background: Diabetes Mellitus (DM) is one of the leading causes of heart failure in current practice, independent of other traditional risk factors for cardiovascular disease and heart failure. Approximately 35,000 children and adolescents in Saudi Arabia suffer from Type 1 Diabetes Mellitus (T1DM).

Objective: To evaluate echocardiography and abdominal ultrasound findings among T1DM adolescent associated with DM duration and hemoglobin A1C (HbA1C) level.

Setting: Aseer Central Hospital, Saudi Arabia.

Design: A Retrospective Study.

Method: Thirty patients who had ECHO, abdominal ultrasound, and thyroid ultrasound between January 2019 and June 2019 were reviewed. Data was entered in SPSS software for analysis.

Result: Thirty patients were reviewed. Twenty-one (70%) were female. Male Mean±SD age was 12.5±3.16 and female was 14±2.9. Sixteen (43%) patients had ECHO for hypertrophied dilated cardiomyopathy (HCMP) and out of those 16, 4 (13%) patients had positive HCMP.

Conclusion: High incidence of thyroid disorder associated with T1DM indicates that antibodies are formed against thyroid tissue. We did not find any significant association between abdominal ultrasound and ECHO of HCMP compared to HBA1C and duration of diabetes.

T1DM (previously called juvenile-onset diabetes mellitus or insulin-dependent diabetes mellitus) is caused by the deficiency of absolute insulin; the main reason is the loss of the insulin-producing beta cells of the pancreas[1].

DM is one of the leading causes of heart failure in current practice, independent of other traditional risk factors for cardiovascular disease and heart failure. The frequency of liver-related disease among DM patients is approximately 17% to 100%[2-5]. Many studies reported the association between thyroid diseases and type I DM[6-8]. The incidence of vitamin D deficiency in patients with T1DM ranged from 15% to 90.6%[9-10]. Biochemical and clinical vitamin B12 deficiency has been demonstrated to be highly prevalent among patients with type 1 and type 2 diabetes mellitus[11-12].

Approximately 96,000 children under the age of 15 years are identified as T1DM patients yearly and the number is projected to be greater than 132,600 when the age group includes the 20s[13-14]. Overall, 1,106,200 individuals under 20 years are assessed to have T1DM worldwide[15-16]. The prevalence is of T1DM in children in the US, India and Brazil is high. In the United States, the prevalence of type 1 diabetes at 18 years of age is approximately 2 to 3 per 1,000[17].

* Assistant Professor
  Specialized Medical Complex, Abha
** Consultant
  Diabetic Center, Assir Central Hospital
*** Consultant
  Department of Child Health
  King Khalid University
**** Consultant
  Pediatric Department
  Abha Maternity and Children's Hospital
***** Consultant
  Department of Pediatrics
  King Faisal Medical City
****** Consultant
  Department of Child Health
  King Khalid University
  Kingdom of Saudi Arabia.
  E-mail: muhammadabidkhan@gmail.com

The American Diabetes Association guidelines for the diagnosis of DM states that the glycated hemoglobin test is more suitable to diagnose diabetes, in which A1c test for two different days is higher than 6.5 percent[18].

In children, fatty liver usually occurs due to metabolic causes such as obesity and insulin-resistant diabetes and is reported to affect approximately 10% of children. In Saudi Arabia, approximately 26% of the population (33.3 million) are meeting the adolescents' age criteria. According to the Diabetes Atlas (8th edition, 2017), almost 35,000 children and adolescents in Saudi Arabia have suffered from T1DM, which makes Saudi Arabia ranked the 8th in TIDM and 4th in the world in frequency rate (33.5 per 100,000 individuals) of TIDM[19-20].

However, the number of studies conducted in Saudi Arabia on the frequency, prevalence, and socio-demographic characteristics of T1DM is inadequate.

The aim of this study is to evaluate the echo and abdominal ultrasound findings among T1DM adolescents associated with DM duration and hemoglobin A1C (HbA1C) level.

METHOD

All adolescent patients with a diagnosis of diabetes between January 2019 and June 2019 were reviewed and included in this study. Laboratory tests, ECHO, abdominal ultrasound and thyroid ultrasound were documented. The inclusion criteria were Type 1 DM, age less than 18 years, DM duration of more than 5 years. The exclusion criteria were any congenital heart disease or chronic liver diseases.

Data were analyzed using the SPSS version 20 software. Chi-square test and ANOVA test were used to measure the significant differences among the variables. A P-value of less than 0.05 was considered significant. Pearson Correlation test was also applied.

RESULT

Thirty patients who had ECHO, abdominal ultrasound and thyroid ultrasound between January 2019 and June 2019 were reviewed. Six (20%) patients had Celiac diseases and 24 (80.0%) had a negative result, see table 1. Twenty-one (70.0%) patients were using insulin alone, 8 (26.7%) were using insulin plus thyroxin and 1 (3.3%) was using continuous subcutaneous insulin infusion (CSII) plus thyroxin.

Six (20%) patients had a nodule on ultrasound and 24 (80%) did not; 10 (33.3%) had heterogeneous neck ultrasound parenchyma while 20 (66.7%) had homogenous neck ultrasound parenchyma, see table 1.

Twenty-one (70%) patients were females. Male mean±SD age was 12.5±3.16 and female was 14±2.9. Sixteen (43%) patients had done ECHO for hypertrophied dilated cardiomyopathy (HCMP) and 4 (13%) patients had positive HCMP, see table 2 and figure 1.

Week negative correlation was observed between BMI and HbA1C, while week positive correlation was observed with

age and Vitamin D deficiency. We did not observe a significant relationship between abdominal ultrasound findings and ECHO hypertrophied dilated cardiomyopathy (HCMP) while comparing them with HbA1C.

Thirty patients had abdominal ultrasound, five (16.7%) had positive HDCM (P=0.104). Retinopathy was within the normal limit (WNL) in all patients, neural complications were not present in any patients; 7 (23.3%) had dyslipidemia while 23 (76.7%) had no dyslipidemia; 6 (20%) had hypothyroidism; 28 (93.3%) had no obesity problems; only one (3.3%) patient had HTN; DKA was present in 13 (43.3%).

Table 1: Celiac Disease

Celiac diseases

	Frequency	Percent
Negative	24	80.0
Positive	6	20.0
Total	30	100.0

Current treatment

	Frequency	Percent
CSII+thyroxin	1	3.3
insulin	21	70.0
insulin+thyroxin	8	26.7
Total	30	100.0

Neck ultrasound nodule

	Frequency	Percent
No	24	80.0
Yes	6	20.0
Total	30	100.0

Neck ultrasound parenchyma

	Frequency	Percent
Hetero	10	33.3
Homo	20	66.7
Total	30	100.0
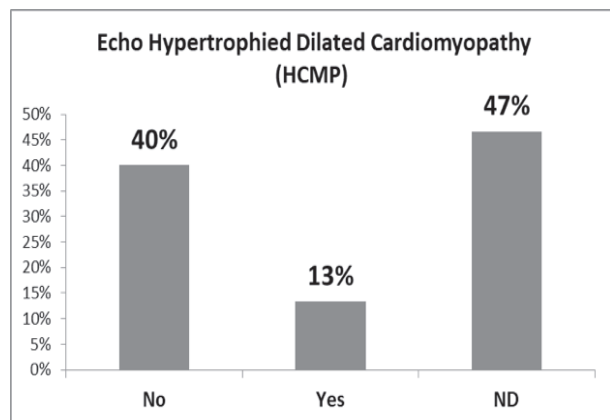
Figure 1: Echo Hypertrophied Dilated Cardiomyopathy (HCMP)

Table 2: Male and Female Patients with T1DM

Parameters		Male	Female	P-value
Age (MEAN ± S.D)		12.5± 3.16	14 ± 2.9	0.23
HBA1C (MEAN ± S.D)		11.4 ± 1.77	10.59 ± 1.8	0.26
Vitamin D deficiency (MEAN ± S.D)		19.19 ± 6.17	18.2 ± 6.9	0.71
BMI (MEAN ± S.D)		16.5 ± 1.52	19.4 ± 2.9	0.0001
Retinopathy	Yes	0	0	N.A
	No	9	21	
Neural complications	Yes	0	0	N.A
	No	9	21	
Kidney complications	Yes	1	3	0.0001
	No	8	18	
Dyslipidemia	Yes	1	6	0.0001
	No	8	15	
Hypothyroidism	Yes	3	15	0.0001
	No	6	6	
Obesity	Yes	2	0	0.0001
	No	7	21	
HTN	Yes	1	1	0.0001
	No	8	20	
DKA	Yes	4	9	0.0001
	No	5	12	
Echo HCMP	ND	3	11	0.0001
	No	5	7	
	Yes	1	3	
Neck US nodule	Yes	1	5	0.0001
	No	8	16	
NECK ULTRASOUND PARENCHYMA	Heterogeneous	3	7	0.0001
	Homogenous	6	14	
Abdominal Ultrasound	Yes	9	21	0.001
	No	0	0	
Celiac diseases	Positive	1	5	0.001
	Negative	8	16	
Current treatment	CSII+thyroxin	0	1	0.0001
	Insulin	6	15	
	Insulin+thyroxin	3	5	

DISCUSSION

T1DM is a worldwide health issue as it is one of the most common metabolic and endocrine disorders which mainly affects children and adolescents[20,21]. The incidence of T1DM is rising with an approximately 4% increment yearly. The incidence of T1DM in Saudi Arabia is rising; earlier studies revealed an incidence of T1DM in children aged 0 to 14 years to be as high as 27.5%[19]. In our study, the majority of the patients were females. The mean age of males was 12.5 years and 14.0 years for females. Although most studies have shown a slight male predominance; the mean age observed in our study was similar to that reported by other studies[22].

T1DM is an autoimmune disorder characterized by the formation of autoantibodies directed against the β cells of the pancreas, it results in a relative or absolute deficiency of insulin. Therefore, lifelong insulin therapy is the mainstay of T1DM treatment. Common forms of insulin therapy such as basal-bolus, multiple daily injections (MDI), or continuous subcutaneous insulin infusion (CSII) are used for managing T1DM[23].

In our study, regular MDI was the most common form of insulin treatment. A similar finding was observed by Mahmood et al, in which MDI form of insulin was most commonly prescribed[24]. MDIs are the preferred form of insulin at the beginning of insulin therapy as one of the disadvantages of CSII is hypoglycemia seen in the initial stage of therapy[25].

Our study group included adolescents, most of which were on MDI. Eight (26.7%) patients were on a combination of insulin and thyroxin, indicating that they were suffering from hypothyroidism. This is most likely due to the fact that both are autoimmune disorders and hence antibodies are formed against both beta cells of the pancreas and thyroid gland. It has been reported that 17 to 30% of T1DM may have associated thyroid disorder and 25% of T1DM children had thyroid autoantibodies[26]. In our study, 30% of the patients had associated thyroid disease.

Celiac disease is a chronic autoimmune disorder characterized by antibody-induced villous atrophy of the small intestine. Elfstrom et al found that 6% of T1DM patients had associated celiac disease[27]. Although the exact mechanism is not known, it is postulated that cross-reactivity of antibodies could play a role in their association.

HbA1C is an indicator of glycemic control in the past three months. As it reflects the glycemic control over a period of time, it is a good parameter to predict the development of diabetic complications[28]. Acute or chronic diabetic ketoacidosis and hypoglycemia irreversibly damage the blood vessels, kidneys, retina and nerves.

Although DM is associated with increased weight, we found a weak negative correlation of HbA1C with BMI (r=-0.29, p<0.05). This could be because most of the T1DM patients were in the pubertal age group.

We did not find any significant signs of renal, retinal, or nerve damage. Dyslipidemia is one of the common complications of T1DM was seen in approximately 25% of the patients.

In our study, ECHO revealed that 13% of the patients were suffering from hypertrophied dilated cardiomyopathy (HCMP), which proves that young diabetics are at risk of developing dyslipidemia and cardiac complication earlier than any other complications.

CONCLUSION

We did not find a significant relationship between abdominal ultrasound findings and ECHO hypertrophied dilated cardiomyopathy (HCMP) while comparing them with HBA1C and duration of diabetes. Dyslipidemia was a common complication seen very early in T1DM. Hence, screening T1DM patients for other autoimmune disorders

should be included in the management protocol. However, a prospective randomized controlled study is advised to substantiate our findings.

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