CLINICO-LABORATORY CHARACTERISTICS AND IMMEDIATE OUTCOME IN CHILDREN WITH DIABETES MELLITUS

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ABSTRACT

BACKGROUND

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycaemia resulting from an absolute or relative deficiency of insulin. The burden of childhood diabetes is rising all over the world.

METHODS

This is a descriptive study conducted at a tertiary care hospital. Eighty-five children with diabetes mellitus admitted during the study period were included. Clinical details, laboratory parameters were collected from the medical records and the data was analysed using statistical tests.

RESULTS

Eighty-five children less than 12 years were included in this study. Female: male ratio was 1.43:1. Age wise distribution was 0-5 years (28.24%), 5-10 years (40%), 10-12 years (31.76%). Majority of them were from lower socioeconomic class (71.76%). Family history of diabetes mellitus was present in forty-one children. Majority of them presented with osmotic symptoms like polyuria (82.35%), polydipsia (80%). Forty-six children presented with diabetic ketoacidosis. Type 1 diabetes was diagnosed in 88.24% of the subjects. There were two children with Type 2 diabetes mellitus. The mean RBS at presentation was 470.42 ± 125.02 and the mean HbA1c was 11.05 ± 1.98 . There was no statistically significant difference in the duration of onset of symptoms to diagnosis between the ketotic and non ketotic group. The BMI was in the range 10 to 25, with mean value 15.09 ± 3.39 . There was no mortality among the subjects.

CONCLUSIONS

Type 1 diabetes is still the predominant form of diabetes among children. Osmotic symptoms like polyuria, polydipsia are the most common presenting symptoms. Younger children are more prone to have diabetic ketoacidosis. Awareness of diabetes care is essential for the successful management of the disease.

KEY WORDS

Diabetes Mellitus, Clinical Characteristics, Children, Outcome

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BACKGROUND

Diabetes mellitus is a chronic metabolic disorder characterised by hyperglycaemia resulting from an absolute or relative deficiency of insulin. The incidence of diabetes in paediatric population is increasing over the years. There is also the trend towards younger age of onset.

Type 1 diabetes is the commonest form of diabetes in children. It is characterized by the autoimmune destruction of pancreatic islet β cells and both genetic susceptibility and environmental factors play an important role in the pathogenesis. The other types are type 2 diabetes, neonatal diabetes, maturity onset diabetes of young, drug induced diabetes, diabetes due to the disease of exocrine pancreas and genetic syndromes associated with diabetes.

The children with type 2 diabetes are usually obese and they are not insulin dependent and they develop ketosis less frequently.

The clinical presentation can vary from classic osmotic symptoms to diabetic ketoacidosis. Morbidity and mortality arise from the acute metabolic derangements and the long-term complications. The treatment is life long and strict adherence to treatment and dietary intake is necessary for the good control of the disease. The disease has its impact on physical and emotional development of the children. Some children are unable to cope emotionally with their condition. Diagnosis in a young child may be delayed as they present with subtle and misleading symptoms.

The prevalence of diabetes varies from region to region and population to population, this variation may be due to the difference in the environmental and genetic factors. The overall age adjusted incidence of type 1 diabetes mellitus varies from 0.7 in 100, 000 per year in Karachi (Pakistan) to more than 40 in 100, 000 per year in Finland.¹ The incidence of type 1 diabetes has been reported as 10.5/100000 in a population based study carried out in urban Chennai in 1996.² Registry of youth onset diabetes in India which enrolled individual less than 25 years with physician diagnosed diabetes found that type 1 was the most prevalent form (63.9%), followed by youth onset type 2 diabetes (25.3%).³

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As the prevalence of diabetes vary from place to place, and as there are only few studies on diabetes in children from this part of country this study was conducted. Increased awareness among professionals about the clinical profile, outcome and the changing trends in the diabetes in the paediatric age group helps in the better patient care and helps in attaining better outcome.

Aims and Objectives

To assess the clinical characteristics, laboratory parameters and immediate outcome in children admitted with diabetes mellitus.

METHODS

This is a descriptive study conducted at the department of paediatrics, Government Medical College Kottayam. Medical records of all children aged less than 12 years admitted with Diabetes mellitus, during the period from 2011 to 2017 were reviewed. Base line data including demographic variables, mode of onset, clinical features, type of diabetes, BMI at presentation, laboratory parameters and immediate outcome were analysed.

Diagnostic criteria for Diabetes mellitus include symptoms of diabetes (include polyuria, polydipsia and unexplained weight loss with glucosuria and ketonuria) plus random plasma glucose ≥ 200 mg/dL or fasting (at least 8 hrs.) plasma glucose ≥ 126 mg/dL or 2 hr plasma glucose during OGTT ≥ 200 mg/dL or HbA1c $\geq 6.5\%$. Criteria for diagnosis of Diabetic ketoacidosis include hyperglycaemia (blood glucose ≥ 200 mg/dL), venous PH < 7.3 or bicarbonate < 15 mmol/L with ketonaemia and ketonuria⁴. It is classified as type 1 when presenting without features of insulin resistance like acanthosis nigricans and obesity especially in younger age groups. Diagnosis of type 2 Diabetes is considered when onset is at puberty, insidious onset associated with acanthosis nigricans and obesity. Onset less than 6 months of age is considered as neonatal diabetes. Drug induced diabetes is considered where there is development of new onset of diabetes in patients on drugs known to induce diabetes like steroid, L-asparaginase, cyclosporine⁵. Diagnosis of syndromic diabetes was entertained when there was features of known syndromes. Immediate outcome is defined as either the patient died or recovered with treatment and discharged from the hospital. Socio economic status was assessed using variables like education, occupation and monthly income.

Data was analysed using SPSS version 22. Qualitative data was expressed as number or percentage. Quantitative data was expressed as mean and standard deviation. The independent sample t test was used to compare the mean values. A p value of < 0.05 was considered as statistically significant.

RESULTS

A total of 85 children were admitted during this period. Out of them 50 (58.82%) were females and 35 (41.18%) were males. Mean age at onset of disease was 7.96 ± 3.63 years. Age distribution was, 0-5 years: 24 (28.24%), 5-10 years: 34 (40%) and 10-12 years: 27 (31.76%). Majority of them were from lower socioeconomic class 61 (71.76%), 22 (25.88%) belonged to middle class and 2 (2.35%) were from upper class. Family history of diabetes mellitus was present in 41

(48.23%) cases. The mean body mass index of study group was 15.09 ± 3.39 , ranging from 10 to 25.

Graph 1. Profile of Symptoms of Patients with Diabetes Mellitus

Parameters	Mean $\pm$ Standard Deviation
RBS	470.42 $\pm$ 125.02
Hb A1c	11.05 $\pm$ 1.98
Serum Urea	23.92 $\pm$ 8.35
Serum Creatinine	0.674 $\pm$ 0.23
Serum Sodium	134.59 $\pm$ 5.52
Serum Potassium	4.11 $\pm$ 0.49
PH	7.31 $\pm$ 0.13
HCO ₃	16.45 $\pm$ 5.15

Table 1. Laboratory Parameters of Patients with Diabetes Mellitus on Admission

Parameters	Group	Total No.	Mean	Std. Deviation	t	p Value
Duration of symptoms to diagnosis (days)	Ketotic group	46	12.65	9.219	0.187	0.888
	Non Ketotic group	39	13.03	11.371		
RBS	Ketotic group	46	487.37	114.316	1.57	0.123
	Non Ketotic group	39	445.23	135.145		
Hb A1c	Ketotic group	46	11.0957	1.96604	0.913	0.364
	Non Ketotic group	39	10.6395	2.63348		

Table 2. Comparison of Parameters in Ketotic Group and Non-Ketotic Group

Majority of them presented with osmotic symptoms like polyuria (82.35%) polydipsia (80%). Other presenting symptoms are shown in graph 1.

The mean duration of symptoms before diagnosis was 13.48 ± 10.51 days (range 2 to 60 days) Forty-six (54.1%) children had DKA as the initial presentation. Altered sensorium was observed in 9 (10.59%) children, shock in 5 (5.88%) children and 12 (14.12%) children had dehydration on admission. Among the children with DKA, three children developed acute kidney injury and four had cerebral oedema.

The mean RBS at presentation was 470.42 ± 125.02 (range 280 to 800). The mean HbA1c value was found to be 11.05 ± 1.98 . There was no statistically significant difference in the mean RBS (p value- 0.123) or the mean HbA1c value (p value- 0.364) between the ketotic group and the non ketotic group. Other laboratory parameters are shown in Table 1.

Hypoglycaemic episodes were observed in 12 (14.12%) children during the course of treatment, hypokalaemia in 12 (14.12%) children and 5 (5.88%) children developed hyponatremia.

Type 1 diabetes was diagnosed in 75 (88.24%) children. Two adolescents had type 2 diabetes. Both had acanthosis nigricans, and were obese, their C peptide levels were normal

and autoantibodies negative. Both had family history of diabetes mellitus. There were 3 cases of neonatal diabetes, all three were females. All them had DKA at initial presentation. They were stabilised with insulin, then continued with metformin. Steroid induced diabetes was seen in 2 children. One was a 3 years old boy with nephrotic syndrome and another a 11 years old girl diagnosed as Systemic lupus erythematosus and on steroid. A case of Praderwille syndrome and a Klinefelter syndrome was diagnosed with diabetes. One β Thalassemia major patient who had repeated blood transfusions developed diabetes mellitus secondary to haemochromatosis.

The duration of illness ranged from 2 to 60 days with mean value of 13.48 ± 10.5 days. The mean duration of symptoms to diagnosis in ketotic group was 12.65 ± 9.21 days and that in non ketotic group was 13.03 ± 11.37 days. There was no statistically significant difference in onset of symptoms to diagnosis in ketotic and non ketotic group (p value- 0.888). Fever was encountered in 22 patients, among them infection was identified in 16 patients. Thirty two percent of patients with DKA had infection on admission.

DISCUSSION

Diabetes is a chronic condition that requires proper monitoring and control. Lack of proper management can increase the risk of complication.

In the present study we included 85 children. Gender distribution showed female preponderance, female: male ratio 1.43:1. Similar observation was reported in the study from Dhaka (Female to male ratio 3:1).⁶ The mean age at presentation in our series was $7.96 \text{ year} \pm 3.63$. This is in agreement with other studies from India, that by Durga Prasad et al⁷ (mean age $\pm$ SD 8.12 ± 3.7). In the current study, it was observed that majority of the study population (71.76%) were above 5 years of age and only 28.24% in 0-5 years age group. In a study carried out in Karnal district Haryana, prevalence of Type 1 Diabetes was found to be 22.22/ 100000 in 5- 16 years, while 3.82/100000 in 0-5 years age group⁸. In type 1 diabetes peaks of presentation occur in two age groups, one at 5-7 years of age and another at the time of puberty¹. Majority (71.76%) of the children were from the lower socioeconomic status. This may be due the fact that ours being a government health care centre most of the patients admitted were from lower socioeconomic class.

Family history of diabetes was present in forty-one (48.23%) patients which is similar to study from Libya (48%).⁹ Among them only 12% of children had affected 1st degree relatives. Most (85%) of the new case of type 1 diabetes occur in persons without an affected 1st degree relative¹⁰. The BMI in our study population ranged from 10 to 25, with mean value 15.09 ± 3.39 . Malnutrition was prevalent among our study population. The duration of illness ranged from 2 days to 60 days. There was no statistically significant difference in the mean duration of symptoms to diagnosis in children with ketotic symptoms when compared to those without ketotic symptoms. This is in contrast to the observation made by Varadarajan P et al,¹¹ were a statistically significant difference was noted ($P < 0.001$). Early diagnosis and treatment can reduce the incidence of DKA.

Classic symptoms like polyuria, polydipsia, weight loss were the main presenting symptoms in our study population,

similar observation was reported in other studies also.^{12,13,14} In this study Diabetic ketoacidosis at initial presentation was noticed in more than half of the subjects. The reported frequency of DKA as the primary presentation varies from 15 - 67% in type I diabetes in children. In the present study among the twenty-one children below 5 years of age, 71% presented with DKA. Younger children are more prone to have DKA as their primary presentation.^{15,16} Symptoms of DKA may mimic respiratory infection or acute abdomen and there is increased likelihood of missed or delayed diagnosis. Worldwide infection is the most common predisposing factor for DKA, occurring in 30-50% cases.¹⁷ In the index study, 32% of patient with DKA had infection on admission. Type1 diabetes comprised 88.24% of our study population. In the study by Emmanuel Ameyaw et al also type 1 diabetes was the predominant form (84.9%).¹⁸ In the study by Varadarajan P et al¹¹ type 1 diabetes constituted 81%, infantile onset diabetes (9%), disease of exocrine pancreas (3.94%), syndromic diabetes (3%) and type 2 diabetes (0.4%). Life style changes have led to early occurrence of type 2 diabetes in children. The risk factors for type 2 diabetes in children are sedentary life style, obesity and genetic factors. In our study, there was only two children with type 2 diabetes, this may be due to the fact that study group comprised of children less than 12 years of age.

The mean RBS at presentation was 470.42 ± 125.02 . The mean HbA1c value was 11.05 ± 1.98 . It is comparable to a study done in Nepal (HbA1c 10.6 ± 2.7).¹⁹ Hypokalaemia and hyponatremia were the electrolyte disturbances observed. Hypokalaemia occurred in 14.12% of children. Potassium is usually lost as a result of repeated vomiting, osmotic diuresis and secondary hyperaldosteronism which occur as a result of volume depletion. In the present study hypoglycaemic episodes were reported in 14.12% subjects, whereas in a study from Kashmir it was seen in 56.9% patients.²⁰ Hypoglycaemic episodes are the dreaded complications that occur during the treatment of Diabetes mellitus. Children are prone to have hypoglycaemia due to their erratic eating habits, increased sensitivity to insulin and high exercise induced energy expenditure. Among the children with DKA, 6.5% developed acute kidney injury and 8.7% developed cerebral oedema. All of them recovered with treatment and there was no mortality.

The number of children developing Diabetes is increasing rapidly, especially among the younger age groups. Poor glycaemic control is associated with growth faltering and acute and long-term complications. Awareness of diabetes care is essential for the successful management of the disease.

CONCLUSIONS

Type 1 diabetes mellitus is the predominant form of diabetes in children. It constituted about 88.24% of our study population. Majority of them presented with osmotic symptoms. Diabetic ketoacidosis at onset was noticed in 54.1% of children. No mortality was reported in this study. Diabetes education programs both for the community and the professionals and easy access to treatment help to reduce the mortality and morbidity due to diabetes.

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