



CLINICAL PROFILE OF DIABETIC KETOACIDOSIS IN ADOLESCENTS. A STUDY FROM TERTIARY HEALTH CENTRE.

General Medicine

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ABSTRACT

Background: Diabetes Mellitus is a major global concern. It is, therefore, imperative to have a continuous chain of researches.

Aim: To explore trends in our patients with Diabetic Ketoacidosis that can guide for modifying management protocols and can contribute in future institutional, local and global planning.

Methods: Patients, 12 to 20 years, admitted in our hospital with Diabetic Ketoacidosis between, January 2020 to December 2020 was studied.

Results: Changing trends were noted. Fewer patients are presenting with Diabetic Ketoacidosis at initial diagnosis. The severity of the disease was less critical in most of our patients. Readmission rate too was less. Compliance with management guidelines was sometimes deficient. Glycaemic control was poor in preceding months especially in adolescents.

Conclusions: Better awareness about diabetes in adolescent among primary physicians and general public is leading to early diagnoses. Effective education of parents is helping them recognize dangerous symptoms and signs at an early stage. Detection of very high HbA1C is a warning sign of impending Ketoacidosis. Adherence to treatment protocols should be periodically checked and updated.

Recommendations: We recommend adaptation of a programmed approach by a designated team to educate caregivers and patients on entering adolescence. Adolescents should be engaged with bigger share of responsibilities. Those with high HbA1C should get extra counselling. We also recommend studies to explore any causal relationship between exposures after preschool age with development of Type 1DM.

KEYWORDS

DKA, complications of DM, Glycaemic control, Adolescent Diabetes, HbA1c.

INTRODUCTION:

Diabetes Mellitus (DM) is a major global health concern with huge financial and social impact. The last three decades have seen a massive surge in population suffering with this debilitating chronic condition. From 108 million in 1980, the number of diabetic patients increased to 476.0 million in 2017 (1). Fresh estimates for 2030 are 578 million (2). Annual deaths are around 1.6 million directly due to diabetes while morbidities due to complications are colossal (3). While the bulk of these patients have Type 2 DM (T2DM), the global burden of Type 1DM (T1DM) is enormous as well. Recent meta-analysis has shown a global incidence of 15 per 100,000 people, though with a wide variation between regions (4). Approximately 130,000 new cases per year are being added for the age group below 20 years (5). With this global and local background, it is imperative to have a continuous chain of researches related to both T1DM and T2DM and their complications. Researches related to T1DM and its complications were not many a decade back but are more frequent lately (6) (7). With meta-analysis needed more regularly to reassess the related scenario, more researches are required to explore the trends, management practices and outcomes. These can help the institutions and individuals to evaluate the local situation while health planners will get benefitted from meta-analysis based on these regional or institutional studies. Our research was based on the same philosophy with similar objectives. We chose to explore the adolescents admitted in our facility with Diabetic Ketoacidosis (DKA).

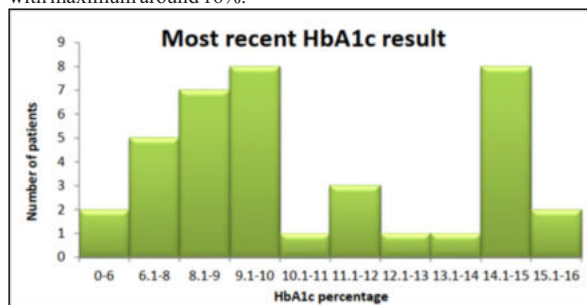
DKA, mainly an issue of T1DM, has high mortality related to the condition itself and during its treatment. Acidosis, dehydration, hypokalaemia and cerebral oedema all need to be catered delicately (8). Protocols have been made to deal with DKA considering all the fine requirements though differences exist between these. Failure to follow these protocols exposed the patient to irreversible damage and death (9). Although, the overall prognosis has markedly improved for patients of DKA, but it remains a major threat. Moreover, the changing trends have been unnoticed, inviting further researches. Our study will help to record and use the details related to DKA at the institutional level and at broader levels as well.

Methodology:

This is a retrospective descriptive analytic study carried out in a tertiary care hospital. All patients 12- 20 years of age, admitted with DKA in medicine ward, between 1st January 2020 to 31st December 2020, were included in the study and were followed for one year. There was no restriction related to sex, residential status or type of DM. Different parameters including past record were explored.

RESULTS:

A total of 100 patients were admitted with DKA in medicine Ward during the study period. Male to Female ratio was 0.9. 3 patients were a new case of Type 1 DM with initial presentation of DKA while all other 97 were known cases, already on Insulin. None of these 100 patients admitted with DKA had Type 2 DM. Out of these, 58 were critical enough to be managed in ICU while 41 were treated in ward. The record has shown that 43 of these adolescents with DKA received bolus stat dose of Insulin, while this practice wasn't found in 56 patients. The record of those 97 patients who were already on Insulin was checked for recent HbA1C (within last 3 months). Results were as under. Thus only 17 patients had HbA1C less than 8% in months preceding the development of DKA while 79 had the levels above 8, with maximum around 16%.



DISCUSSION:

Are Their New Risk Factors After The Preschool Age?

Out of 100 patients of DKA that we received during the study period, despite young age being a known risk factor for DKA, the incidence of DKA in children under 4 in our study was very low. It may be an indirect reflection of changing prevalence of T1DM in different age groups, locally and internationally. Less number of cases in a certain age group will automatically lead to fewer presenting with a complication. The risk of developing T1DM increased by 1.4% annually in adolescents in the decade from 2002 to 2012. A recent study from New Zealand is also showing a plateau in the incidence of Type 1DM in adolescent age in the last decade though this is not the case in older adolescent where a constant rise has been noted (11). Are there new risk factors after the adolescent age? Large scale researches are needed to explore the new exposures which adolescent are getting and then establishing a causal relationship of those with the development of T1DM. We strongly recommend related researches as otherwise the situation will continue worsening, burdening the

patients, families and health care system.

DKAs As An Initial Presentation. The Trend Is Changing:

DKA as an initial presentation of Diabetes Mellitus is known. Emergency and primary care doctors are required to be conscious about the possibility of DKA in previously undiagnosed patients presenting with symptoms suggestive of DKA especially with respiratory symptoms in cold and flu season (12). In studies done a decade back, DKA as initial presentation was common and as high as 67% in few studies (13). A lot of variation has been documented among different countries in relation to percentage of patients having DKA at the time of initial diagnosis. Saudi Arabia, UAE, Taiwan was noted to have these percentages around 60% or more while Finland, Canada and Sweden had around 20% new cases with DKA (14). However, in our study only 3 patients out of 100 was previously not a known case of DM. This cannot be declared as a confirmed trend due to the limitation of being from a single centre. Similar trend, however, has been observed in bigger studies. In Finland despite having the highest prevalence of T1DM (54 cases per 100,000), the percentage of DKA at diagnosis is continuously decreasing (15). This change is attributed to implementation of Type 1 Diabetes Prediction and Prevention Project (DIPP). Similar trend was recorded in a recent study from Saudi Arabia (16). Our findings support the impression that primary clinicians as well as general public are now more aware of existence of DM in adolescent and possible symptoms to suspect this. Thus, patients are being diagnosed early, prior to getting worst and developing DKA. Although there is a gradual increase in Type 2 DM in young adolescent with increasing morbidity but T1DM remain the one with chances of developing DKA (17). All patients in our study had T1DM.

Effects Of Family Education, On The Severity Of DKA And The Rate Of Readmission.

A Cost-effective Approach:

Role of parents in the management of DM in adolescent cannot be overemphasized. Education of parents is cornerstone in this context. It is a very broad platform with multiple facets including initial acceptance and adaptation, knowledge of pathophysiology, familiarity with different types of insulins, patient's and own psychological stresses, food exchanges, etc. (18). An important aspect is teaching the caregivers about how to recognize the complications mainly hypoglycaemia and DKA, at the earliest. Early recognition of these can save morbidity and mortality (19). In our study, 58 out of 100 patients needed ICU care on admission despite a confirmed diagnosis of DKA. It was because the patients were brought at an early DKA state before the condition becomes critical. Even among those admitted in ICU, most were shifted to medicine ward within 2 days and only 5 patients needed ICU stay for more than 2 days.

We believe that this is a positive reflection of parental understanding of early signs and symptoms of DKA secondary to learning from direct teaching being done at our health facility in addition to indirect information through media. We have a comprehensive parental education program at our institute. We recommend a deliberate and structured effort for continuation of related education for all caregivers including parents, elder siblings' teacher. We believe that education during admission with DKA is mandatory for more awareness and avoidance of DKA in future. Exploring the specific cause (like non-compliance, failure of insulin pump, infections, dehydration, inadequate medical supplies, etc.) leading to DKA in every admitted adolescent, can help in reducing the re-admission rate.

Non-adherence to protocols. The issue of bolus insulin before infusion:

In management of DKA, Insulin has a central role. Decades of experience in treating patients of DKA throughout the world has proved that laid down guidelines have to be followed for positive results. Failure to do that can result in life threatening complications. It is universally accepted that Insulin should be administered as a continuous IV infusion, using short-acting or regular insulin for treating hyperglycaemia and clearing ketonemia. Bolus dosing given in an attempt to treat the ketoacidosis quickly may increase the danger of cerebral edema and severe hypokalaemia (22). Despite this wide acceptance, the execution is not always there. In our study, 43 out of 100 patients received stat bolus dose of insulin beside the recommended Insulin through IV infusion. This high percentage is alarming. However, even in setups under well-established healthcare system, the guidelines are not being fully followed. High variability in

adherence to the guidelines for DKA management were observed using high-fidelity in situ simulation in a study carried in State of Indiana, USA. Besides other mistakes, 30.6% participants of DKA management teams incorrectly administered insulin boluses (23). In a related Austrian study, only 60% clinicians dealing with DKA were adherent to the existing and accepted protocol (24). We strongly recommend that all those involved in managing DKA patients including emergency doctors, physicians, paediatric endocrinologists, general paediatricians, intensivists and nurses working with them should be periodically reminded. They should be regularly checked by different means regarding knowledge of and adherence to existing protocol and guidelines. It may worth saving many lives as errors in DKA management are costly with little margins.

Glycaemic Control. Need To Adjust Strategy When Your Patient Enters Adolescence:

The long-term complications of DM are dependent mainly on glycaemic control although other factors do contribute as well. After the Diabetes Control and Complications Trial (DCCT) from 1983 to 1993 on Type 1 DM patients, the relationship was evident for subsequent risk of diabetic retinopathy, neuropathy and nephropathy. The long-term benefits of good Glycaemic control, on both microvascular and macrovascular complications, were proved in Epidemiology of Diabetes Interventions and Complications (EDIC) study, where the same patients of DCCT were further followed (25). In an Indian study, poor glycaemic control was found to accelerate the complications in adolescents with T1DM even with shorter duration of illness resulting in significant morbidity and considerable mortality (26). Recent recommendations of International Society for Paediatric and Adolescent Diabetes (ISPAD) and American Diabetic Association (ADA) are to target HbA1C of 7.5% (58.5 mmol/mol) in all children with diabetes mellitus (27).

In our study more than 80% of patients admitted with DKA had their HbA1C exceeding WHO recommended values when checked in the last 4 months prior to development of DKA. Half of these patients have their HbA1C more than 11, with most having values between 14 to 15%. This is different from larger multi-centre studies like SWEET where 39% children and adolescent were found maintaining HbA1C under 7.5% (28). A high HbA1C is not only an indicator of poor glycaemic control but also a warning sign for impending DKA. We recommend, as a policy, that all those detected with very high HbA1C on routine follow-up should get extra counselling regarding the danger, symptoms and home checks related to DKA. We also found that HbA1C values in the preceding months prior to developing DKA were markedly high in teenagers/adolescents. They were also the most common group presented with DKA, as discussed earlier. In the age group 13-16 years, comprising 31 percent of patients, the average HbA1C was 10.8%. In the age group 17-20 years, comprising 37 percent of patients, it was an alarming 13%.

So, what makes an adolescent prone to poor glycaemic control? Adolescence is an age of transition. A patient with T1DM is undergoing a lot of biological, social and psychological changes during this period. Besides the pubertal changes, directly affecting the sugar levels and Insulin requirements, patient is becoming more independent and the strict parental control, especially on food intake, can no more be exercised. A recent study in Brazil on T1DM adolescents, pointed out that both age and duration influenced the HbA1C levels even with good check on type of food intake and accordingly teenagers are expected to have higher levels (29). An irregularity in intake of carbohydrates however remains the prime factor in adolescents.

Studies have shown that poor quality of life (QoL) scores, impaired family functioning, poor coping skills, and lower socioeconomic status adversely affect glycaemic control in adolescents even if all other parameters like age, gender, pubertal status, insulin regimen and types, duration of illness are same (30). Psychosocial elements are, therefore, extremely important in adolescents with DM and their consideration in management plan is critical. At the same time, the patient is becoming more mature and knowledgeable which should be used positively. We believe that taking him or her on board, developing a closer friendly rapport and giving larger share of responsibilities are excellent tools to ensure a good Glycaemic control beside ameliorating the psychological stress. A deliberate, programmed plan to deal with every adolescent with DM should be the policy for every institution responsible for managing these patients and should involve a

designated team. Our study has the limitation of being a single institutional study. We recommend all tertiary care facilities taking care of Diabetic patients including those with DKA, to do such studies for local audit and for contribution towards meta-analyses. We also feel that our study will help individual doctors responsible for managing T1DM patients by revisiting their practices related to presence and adherence to DKA protocol, education of parents in general and patients during adolescence.

CONCLUSION:

Diabetes Mellitus due to its volume and associated morbidity and mortality remains a major health concern. Regular research activity is required as the incidence of both Type1 and Type2DM is on the rise. DKA, being a life-threatening complication, was studied in our patients. Fewer patients are presenting with DKA at initial diagnosis than in past. This may be due to early diagnoses secondary to better awareness. Similarly, effective education of parents is resulting in DKA being recognized at less critical stage and also causing less readmissions. Parental education is an extremely fruitful and cost-effective method to decrease mortality and morbidity. It should be recognized and delivered religiously. Compliance with management guidelines is sometimes deficient and should be emphasized by periodic checks. All those with very high HbA1C should get extra counselling about signs and symptoms of DKA and home checks related to DKA. Glycaemic control is poor in adolescents. We recommend a programmed approach by a designated team to educate teenagers on entering and during adolescence with bigger share of responsibilities. Larger studies will help in recognizing the noted changing trends.

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