A Medical Audit on Management Protocol of Diabetic Ketoacidosis in EMW

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Introduction:
Diabetic ketoacidosis, a known complication of diabetes mellitus caused by the build up of by-products of fat metabolism (ketones), which occurs when glucose is not available as a fuel source for the body[1]. It is defined as hyperglycemia (blood sugar > 250mg/dl), acidosis (pH <7.3), ketonemia (positive at 1:2 dilution), ketonuria and dehydration (approx. 6L loss)[2]. Its incidence varies among developed and underdeveloped countries. The annual incidence of DKA among subjects with type 1 diabetes is between 1% and 5% in European and American series[3-6] respectively. This incidence appears to have remained relatively constant over the last decade in Western countries where as 20-30% of cases occur in newly diagnosed patients[7]. Mortality rate is reported less than 5% in experienced centres[7-12] but with increase in age, this approaches to 50% in patients over the age of 80[13]. Internationally overall mortality is reported between 1-10 percent[14]. In a survey by WHO, it was shown that in 1995, Pakistan was 8th on the list of Top Ten Countries with high prevalence of diabetes and had 4.3 million people with diabetes mellitus. However it is estimated that in the year 2025, Pakistan will be 4th on the list with 14.5 million people with this disease[15]. Common causes of diabetic ketoacidosis include infection, particularly pneumonia, urinary tract infection, and sepsis, inadequate insulin treatment or non-compliance, new-onset diabetes, cardiovascular disease particularly myocardial infarction[16,17]. Diagnosis is suspected on clinical history and examination even in the unconscious patients where history of diabetes may be available[2], but to confirm the diagnosis investigations including blood sugar level, pH, serum bicarbonate, urinary ketones and serum ketones are required[18]. The aims of DKA management are to correct the acidosis, hyperglycaemia, dehydration and electrolyte disturbance associated with the condition and to identify and treat any associated co morbid events. This requires appropriate and rapid clinical assessment and frequent monitoring of the patient[9].

Objectives:
- To devise a management protocol for patients of diabetic ketoacidosis.
- To find out mortality rate in patients of diabetic ketoacidosis admitted in East Medical Ward

Criteria of audit: Diagnosis of diabetic ketoacidosis is based upon the diagnostic criteria shown in table 1[(2, 3)] and the therapeutic goals for diabetic ketoacidosis consist of improving circulatory volume and tissue perfusion, reducing blood glucose and serum osmolality toward normal levels, clearing ketones from serum and urine at a steady rate, correcting electrolyte imbalances and identifying the precipitating factors as per recommendations of American Association of Diabetes[2, 3] where as mortality is less than 5%[7-12].

Table 1; Diagnostic Criteria for Diabetic Ketoacidosis[2,3]

Blood Glucose >250mg/dl
pH<7.3
Serum Bicarbonate <15mEq/L
Urinary Ketones positive
Serum Ketones positive at 1 to 2 dilution
Plasma osmolality variable

Standards of audit: All patients should be diagnosed and managed as per recommendations of American Association of Diabetes and mortality should be less than 5%.

Material and methods:
A retrospective medical audit was conducted on patients admitted in East Medical Ward from January 2004 to July 2005 with a diagnosis of diabetic ketoacidosis. There were 44 patients included in this audit fulfilling the following criteria.

- Patients between the age of 13-80 years.
- Patients whose blood sugar level was > 250mg/dl.
- Patients whose blood pH was < 7.3.
- Patients who had positive urinary ketones.

Patients who had initial blood sugar level more than 250mg/dl and later found to have negative urinary ketones were excluded from the audit. Data was collected on a predesigned proforma and was analysed by the programme SPSS version 10.

Results:
We found that mean age of the patients was 35.39 ± 18.26 years including 21 (47.7%) males and 23 (52.3%) females. Fourteen (31.8%) patients had their first presentation as diabetic ketoacidosis where as rest of the patients were known diabetics including 56.8% diabetic for less than 10 years and 11.4% diabetic for more than 10 years. Blood sugar level of all the patients was checked at presentation and none of them had blood sugar level less than 250mg/dl and record was missing for 3 patients (Table 2).

Urinary ketones of 44 patients were found to be positive with a max.no. 20 (45.5%) having 4^+ ketones where as 3 had their record missing (Table 3).

We found that out of 44 patients arterial blood gases record of 36 (81.8%) patients was available (mean pH = 7.0786,mean pCO2 = 22.231, mean HCO3 = 12.867) and 8 (18.2%) had their record missing.

Serum electrolytes investigation record showed that 11 (25%) patients had their record missing for serum Na^+ and K^+. Rest of the patients had their record available in which serum Na^+ ranged from 131 to 151 mEq/L where as serum K^+ values showed that only 1(2.3%) patient had hyperkalemia (serum K^+ >5.5) and 4(9.1%) had hypokalemia (serum K^+ <3.5).

Table 2; Blood sugar level on presentation (n=44)

	Frequency	%age
201-300	4	9.1
301-400	10	22.7
401-500	15	34.1
501-600	9	20.5
>600	3	6.8
Record missing	3	6.8

Renal profile record showed that blood urea values of 18 (40.9%) patients was missing and rest had their record available, evitable from figure 1, where as serum creatinine record of 17 patients (38.6%) was missing, 7(15.9%) had raised (>1.5mg/dl) and 20(45.5%) had normal investigation report (Fig.2).

	Frequency	%age
Urine ketones 1+	1	2.3
Urine ketones 2+	7	15.9
Urine ketones 3+	13	29.5
Urine ketones 4+	20	45.5
Record missing	3	6.8

We found that blood complete examination reports were available for only 50% of patients where as they were missing for 27.3% and not done in case of 22.7% patients. We found that fluid intake monitoring was done for all the patients and records were missing for 3(6.8%) patients where as output monitoring record was missing for 13 (29.5%) patients.

Precipitating factors were also looked for and we found infection to be the most common cause. Other causes included myocardial infarction, non compliance and surgery where as in 25% cause was not known (table 4).

Table 4; Precipitating factors (n=44)

	Frequency	%age
Not known	11	25.0
Infections	20	45.5
M.I.	2	4.5
Non compliance	5	11.4
Surgery	1	2.3
Others	5	11.4

Antibiotics were given to all 44 patients depending upon the cause of infection suspected on history and clinical examination as blood culture of none of the patient was sent.

Regarding outcome of patients 84.1% of patients were either discharged, discharged on request or left against medical advice where as 15.9% patients expired (Figure 3).

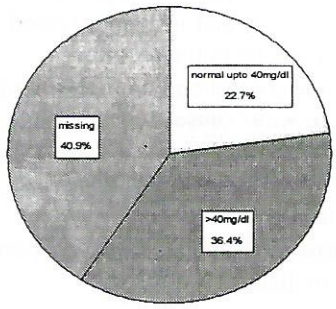

Figure 1; blood urea on presentation

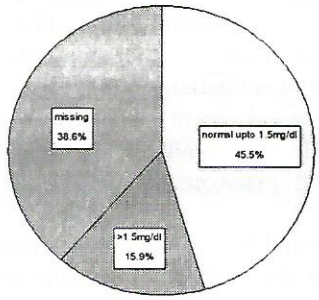

Figure 2; serum creatinine on presentation

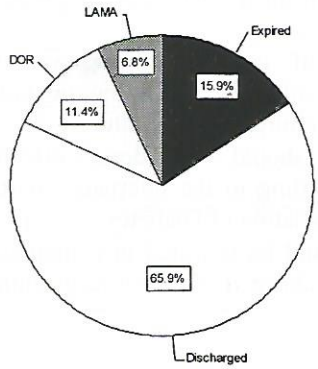

Figure 3; outcome of patients

Comments:

As it is evident from results that basic investigations necessary for the diagnosis of diabetic ketoacidosis were missing for some of the patients admitted in East Medical Ward including urinary ketones and arterial blood gases. These investigations are necessary for the diagnosis as per recommendations of American Association of Diabetes[2] and should be done in all patients.

The commonest cause we found as a precipitating factor was infection (45.5%) which is same as in other

studies conducted in USA (30-50%) [20], Pakistan Institute of Medical Sciences Islamabad (40%)[21] and Lady Reading Hospital and Khyber Teaching Hospital Peshawar (28%)[22], but it is less than what was found in Chang Gung Memorial Hospital, Taipei (70%)[23]. The mortality at our centre was found to be 15.9% which is much higher as compared to other studies where it was around 5%[20,21,22,23]. Possible reasons for the discrepancies might be:

- Improper documentation and improper record keeping which led to missing data in the records.
- Improper glycaemic control and compliance on part of the patient which can cause repeated attacks and increased mortality.
- Late presentation with severe acidosis can be the cause of high mortality.
- Delay in diagnosis and management on part of the doctors can lead to high mortality.

Suggestions

- More stress should be laid on patient education regarding compliance and early recognition of sign and symptoms of diabetic ketoacidosis and information leaflets regarding diabetic emergencies should be available in out patients.
- A flow sheet management plan for diabetic ketoacidosis should be available in management charts. A proposed management plan is shown in figure 4.
- Record keeping should be made more efficient so that we could decrease the number of missing values in data.
- Documentation should be proper and senior doctors must check that all the medications given have been entered in the chart.
- All patients of diabetic ketoacidosis should be subjected to infection screening including blood culture, urine culture, sputum culture.
- Management should be done effectively and vigilantly according to the international standards of American Association of Diabetes.
- This audit should be repeated in 6 months time after application of above mentioned suggestions to check mortality.

References:

1. Sidhaye A R. DKA; Ketoacidosis; Diabetic coma.8/6/2004.http:// www .nlm .nih .gov /medlineplus/article/000320 .htm# Alternative % 20Names
2. KITABCHI AE, WALL BM. Management of Diabetic Ketoacidosis. Am Fam Physician 1999;60:455-64.
3. Kitabchi AE, Umpierrez GE, Murphy MB. Management of hyperglycemic crises in patients with diabetes. Diabetes Care 2001;24:131–53.
4. Johnson DD, Palumbo PJ, Chu CP. Diabetic ketoacidosis in a community-based population. Mayo Clin Proc 1980;55:83–8
5. Schiel R, Muller UA, Sprott H. The JEVIN trial: a population-based survey on the quality of diabetes care in Germany: 1994/1995 compared to 1989/1990. Diabetologia 1997;40:1350–7
6. Snorgaard O, Eskildsen PC, Vadstrup S. Diabetic ketoacidosis in Denmark: epidemiology, incidence rates, precipitating factors and mortality rates. J Intern Med 1989;226:223–8
7. Ellemann K, Soerensen JN, Pedersen L. Epidemiology and treatment of diabetic ketoacidosis in a community population. Diabetes Care 1984;7:528–32
8. Faich GA, Fishbein HA, Ellis SE. The epidemiology of diabetic acidosis: a population-based study. Am J Epidemiol 1983;117:551–8
9. Bagg W, Sathu A, Streat S. Diabetic ketoacidosis in adults at Auckland Hospital, 1988–1996. Aust N Z J Med 1998;28:604–8
10. Basu A, Close CF, Jenkins D. Persisting mortality in diabetic ketoacidosis. Diabet Med 1993;10:282–4
11. Carroll P, Matz R. Uncontrolled diabetes mellitus in adults: experience in treating diabetic ketoacidosis and hyperosmolar nonketotic coma with low-dose insulin and a uniform treatment regimen. Diabetes Care 1983;6:579–85
12. Wagner A, Risse A, Brill HL. Therapy of severe diabetic ketoacidosis. Zero-mortality under very-low-dose insulin application. Diabetes Care 1999;22:674–7
13. Krentz AJ, Nattrass M. Acute metabolic complications of diabetes: diabetic ketoacidosis, hyperosmolar non-ketotic hyperglycaemia and lactic acidosis. *In*: Pickup JC, Williams G, eds. Textbook of diabetes. 4th Ed. Oxford: Blackwell Science Ltd, 2003:32.1–32.24
14. Hamdy O. Diabetic ketoacidosis. June2004. http//www. emedicine.com/Specialties/Medicine/Endocrinology
15. World Health Report 2003. World Health Organization (WHO).1211 Geneva 27, Switzerland.
16. Hamblin PS, Topliss DJ, Chosich N, Lording DW, Stockigt JR. Deaths associated with diabetic ketoacidosis and hyperosmolar coma. 1973-1988. Med J Aust 1989;151:439-44.
17. Pinhas-Hamiel O, Dolan LM, Zeitler PS. Diabetic ketoacidosis among obese African-American adolescents with NIDDM. Diabetes Care 1997;20:484-6
18. Ennis ED, Stahl EJ, Kreisberg RA. Diabetic ketoacidosis. *In*: Porte D Jr, Sherwin RS, eds. Ellenberg & Rifkin's Diabetes mellitus. 5th ed. Stamford, Conn.: Appleton & Lange, 1997;827-44
19. English P and Williams G. Hyperglycaemic crises and lactic acidosis in diabetes mellitus ,Postgraduate Medical Journal 04;80:253- 261
20. Umpierrez GE, Kitabchi AE. Diabetic ketoacidosis: risk factors and management strategies. Treat Endocrinol. 2003;2(2):95-108.
21. Bashir T, Zafar J, Sharif M, Qazi R A, Siddiqui S, Ambreen S et al. Diabetes ketoacidosis: clinical presentations and precipitating factors J Pakistan Inst Med Sci Jul 04;15(1):857-61.
22. Ahmed F, Zafar S, Khan H. Precipitating factors for Diabetic Ketoacidosis Med Channel Sep 2004;10(3):48-50
23. Lin SF, Lin JD, Huang YY. Diabetic ketoacidosis: comparisons of patient characteristics, clinical presentations and outcomes today and 20 years ago. Chang Gung Med J. 2005 Jan;28(1):24-30.

Fig.4; Suggested Flow Sheet Management Plan for Diabetic Ketoacidosis

Flow Sheet for Monitoring Diabetic Ketoacidosis

Patient's name: _____ REG.No. : _____

Age : _____ **Sex:** _____

TYPE OF DIABETES

Date:							
GCS							
Temp							
Pulse							
R/R							
BP							
BSL (mg/dL)							
Urinary ketones							
Na^+							
K^+							
B/U S/C							
ABGS							
Insulin							
Intake of fluids/metabolites							
KCL							
Antibiotics							
Urine (mL)							
Other							