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Epidemiological Characteristics of Ketoacidosis Among Korean Diabetic Patients*

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An epidemiological study on diabetic ketoacidosis(DKA)was done by analysis of 207 cases collected from the medical records of 6 major general hospitals in Seoul area during the period of 5 years between 1979 and 1984.

There was female predominance in the occurrence of DKA (male/female ratio, 0.71) in spite of the male predominance in general prevalence of diabetes mellitus (1.80). This female predominance in DKA was most striking in the age group under 40.

There was a significant seasonal variation in the occurrence of DKA. DKA occurred most frequently in colder season with the highest peak in December. In July and August, the hottest season in Korea, not even a single case of DKA was recorded in this series.

No discernible precipitating factor was found in 39.3% of DKA cases and infection was present as a cause of DKA in 30% of cases.

In 27.5%, DKA was the first clinical presentation of diabetes and in the remainders of cases, diabetes was known to be present for average of 6.4 years.

Mortality of DKA was 13.2% in this series.

As to the socioeconomic status, the education level, the style of living and the duration of diabetes, there were not ascertainable differences between the DKA cases and other diabetic cases.

The prospective epidemiological study of diabetic population in Korea, especially in female group, would be necessary for elucidation of the characteristics of DKA in Koreans such as the female predominance and the seasonal difference of the occurrence.

Key Words: *Diabetic ketoacidosis (DKA), IDDM, epidemiology*

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INTRODUCTION

Even though DKA is a common illness among patients with diabetes and remains serious event

with mortality rate of 6–10% (Alberti, 1977; Clements, 1978), there have been only limited number of studies looking into the occurrence of DKA in a community (Johnson, 1980; Faith, 1983; Ellemann, 1984) and most of them are recent.

After introduction of new classification of primary diabetes into insulin dependent diabetes (IDDM) and noninsulin dependent diabetes (NIDDM) by WHO (1985) and NDDG of United States (1979), there have been some difficulties in determining the category of a particular patient.

Classical IDDM, is characteristically prone to DKA, is rather rare in Korea and its diagnosis seems to be hindered by resistance of the patients in accepting the insulin as their primary treatment modality. Authors think these factors and other difficulties made the epidemiologic studies of IDDM in Korea difficult and indeed there had been only scarce information. Authors have reasoned that the epidemiological study on DKA is not only needed in Korea, but mignt serves as a cross sectional study of IDDM.

In this report, authors aimed to characterize the DKA population and with that information tried to characterize the IDDM of Korea in comparison with the western reports.

METHODS

From six major general hospitals located in Seoul, medical records of patients who were diagnosed as DKA during the period of January, 1978 to May, 1984 were collected by the participating researchers.

From these medical records, only those who met the following diagnostic criteria were included in the analysis.

1) Clinical manifestation of typical DKA.
2) Blood glucose level>250 mg/dl.
3) Presence of ketonuria or kteonemia
4) Blood pH<7.34.

The results were compared to the demographic features of the general diabetic patients observed at Seoul National University Hospital during the period of 1977–1982, comprising of 3,767 consecutive patients.

RESULTS

1. Age and sex distribution of DKA

The age and sex distribution of 207 cases with DKA are shown in Figure 1. There were apparently two peaks in their age distribution in both sexes, one

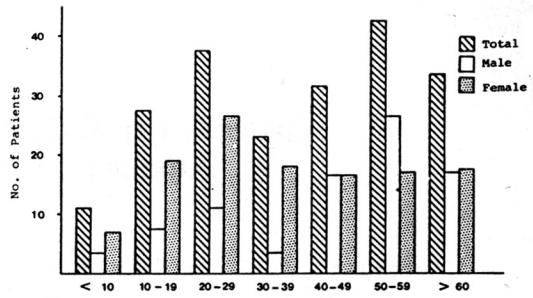

Fig. 1. Age and sex distribution of DKA patients.

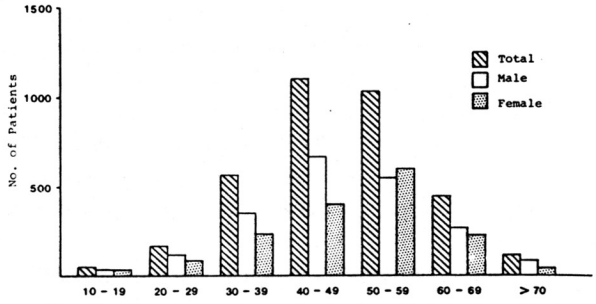

Fig. 2. The age and sex distribution of diabetic patients seen at Seoul National University Hospital, 1977–1982.

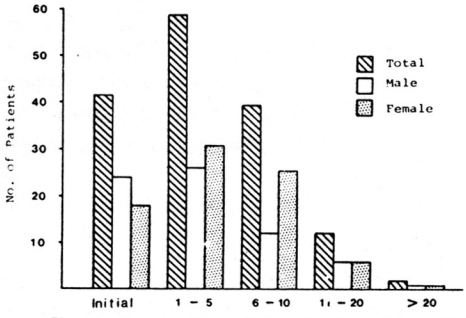

Fig. 3. The duration of diabetes (year) prior to the onset of DKA.

in their twenties and another in fifties. Female patients were more predominant in the first peak, and the male/female ratio was 2.6 under 39 years of age. This age distribution is in sharp contrast to that of general diabetic patients as shown in Figure 2, in that there was only single peak in their forties and no predilection of female diabetics.

2. Onset of DKA according to the duration of diabetics (Fig. 3)

Forty two cases out of 153 patients having clear recording in their onset of diabetes (27.5%) manifested their diabetes as DKA (debut DKA). Most of DKA patients however, gave the history of diabetes

prior to DKA episode. Two patients developed DKA 20 years after diagnosis.

3. Precipitating factors (Fig. 4)

Infection of various kind was the most frequent known precipitating factor for these DKA episodes (30.0%) followed by discontinuation of insulin (16.8%), gastrointestinal disturbance with abdominal pain (4.9%), and other miscellaneous causes (9.0%). 39.3% of DKA patients did not show any clear precipitating factor(s). Because the gastrointestinal disturbance with abdominal pain might be a symptom of DKA itself, some of these patients may not have any clear precipitating factor.

4. Seasonality (Fig. 5)

Seasonal occurence could be analyzed in all cases including 42 cases of debut DKA. There were apparent two seasonal peaks in DKA occurence, one in spring (April, May) and another around December.

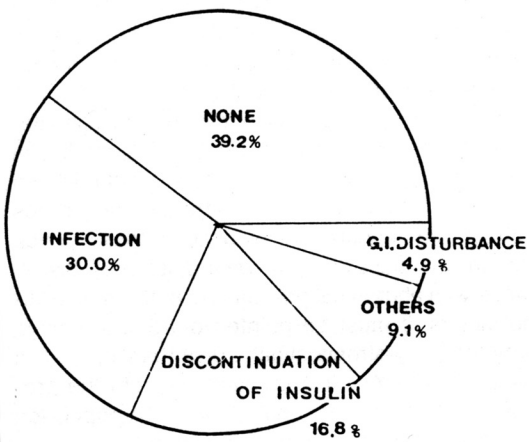

Fig. 4. Precipitating factors of DKA.

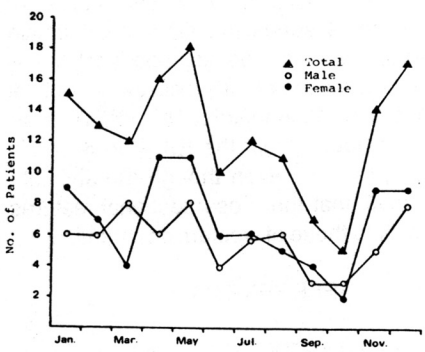

Fig. 5. Seasonal occurrence of total diabetic ketoacidosis.

5. Analysis of debut DKA

Age and sex distribution of diabetic patients who manifested their diabetes as DKA or debut DKA was shown in Figure 6. Even though number was small, there remained clearly two peaks as noted earlier. The first peak, however, was more prominent and the female predominance was more apparent in this analysis. There were only small numbers of female debut cases after their thirties.

Seasonal occurence of debut cases was shown in Figure 7, showing one December peak and no cases being recorded in summer season. Spring peak noted in the analysis of whole DKA disappeared, although small number prevented any meaningful interpretation.

6. Other clinical informations

It was not possible to give clearly how severe our DKA population were, but authors thought most of them were severe cases of DKA. In this series, 16 patients experienced recurrence of DKA, 12 patients had 2 episodes 3 patients had 3 episodes and one patient had 5 episodes. This last patient was a 36 year old married woman with 3 children. Her socioeconomic and intelligence scale were rather

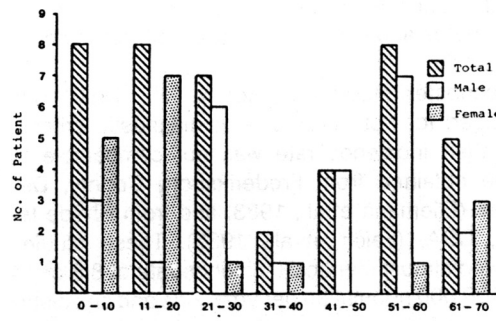

Fig. 6. Age and sex distribution of diabetic patients who manifested DKA as their initial symptom.

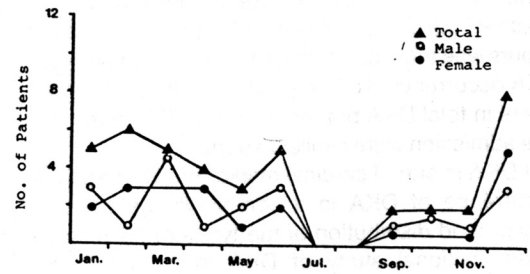

Fig. 7. Seasonal occurrence of DKA patients who manifested diabetes as their initial symptom.

excellent on all criteria. The economic status, educational background, occupation, alcohol consumption, family size were attempted to compare with those of general diabetic populations, but the limited number of collected cases with clear informations prevented the meaningful interpretation. However, from those limited informations, authors found no specific trend for proneness for the development of DKA. Family history of diabetes were recorded in 8 cases, and 13.2% of the patients died of these DKA episodes.

DISCUSSION

DKA is a common illness among the diabetics and it may be severe or mild. There are few studies, however, characterizing the DKA in a community. Johnson et al. (1980) reviewed the data about the reported 92 cases of DKA from Rochester, Minnesota, which had been collected during the 52-year period (1924–1976). Even though their analysis might not be comparable to our data, there are some similar characteristics. Firstly, there was female preponderance in young DKA population with no difference after 30 years of their age. Secondly, more DKA occurred in older age group. Thirdly, time interval distribution between diagnosis of diabetes and initial presentation of ketoacidosis. was sinilar.

Rochester study (Johnson et al., 1980) was criticized for not utilizing clear diagnostic criteria, and their incidence rate was not comparable to those obtained from Frederiksborg County, Denmark (Ellemann et al., 1983) and from Rhode Island, USA, (Faich et al., 1983). These studies showed almost identical incidence rate of 8.5 or 14 per 100,000 population per year. Age and sex distribution of DKA patients in Frederiksborg study appeared very similar to our results and comparable to that of Rochester study. Rhode Island study did not give clear age and sex distribution, but female preponderance of DKA occurrence was apparent. Another interesting similarity of Frederiksborg study to ours was the fact that there were two age peaks in DKA occurrence. Not only the percentage of debut cases in total DKA but the duration of diabetes before admission were similar to ours.

If DKA is one of cardinal marker of IDDM and the occurrence of DKA in a community reflects the background distribution of the types of diabetes, a cross sectional study of DKA might reveal the characteristics on the types of diabetes in a community. As our epidemiologic features of DKA population are almost identical in its characteristics to those of United States and Denmark (Faich et al., 1983: Ellemann et al., 1884), it might be argued that the background population of Korea has the similar distribution of types of diabetes as in United States and Denmark.

This conclusion is, however, in sharp contrast to the clinical impressions of most Korean diabetologists who see very few IDDM. In 1976, a diabetes prevalence survey at southern part of Korea on 13,152 school children (5-15 years old) supported this impression which identified only 3 diabetic children (Lee, 1977), and this figure was comparable to that of larger Japanese study showing 3 childhood diabetes per 100,000 (Kitagawa et al., 1980). Our study, however, did not ascertain all DKA patients in Seoul, and further studies are needed to clarify several uncertainties of our study. However, it may be worthwhile to note that there is another age peak in the fifties in this study as was noted in the Dannish study (Ellemann et al., 1984), even though the authors of the latter study did not mention it. The facts of IDDM incidence being steady after the age of 30 and the peaking of DKA occurrence in 6th decade contradict each other.

Other clinical features of our DKA population appeared quite similar to the most clinical studies in that infection was most frequent among the known precipitating factors and that there are many cases without any apparent precipitating factor. Even though we classified the gastrointestinal disturbance with abdominal pain as one of the precipitating factors, it must be pointed out that the same symptom, gastrointestinal disturbance, is a symptom of DKA. If it is excluded from the precipitating factors almost half of our DKA population appears without any precipitating factor.

In conclusion, the epidemiologic features of Korean DKA patients appear quite similar to those of the western patients' series, in that there are female preponderance, two age peaks, seasonal variations, similar percentage of debut cases out of total DKA and its precipitating factors. This might be regarded as an evidence that the IDDM in Korea is present in such a way, even though the absolute number is small, that the cross-sectional features are quite similar to those of western countries.

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