

อุบัติการณ์ของการเกิดภาวะคีโตะซีโดซิสในผู้ป่วยที่มีระดับน้ำตาลในเลือดสูง ในห้องฉุกเฉินโรงพยาบาลหาดใหญ่

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บทคัดย่อ

คีโตะซีโดซิส เป็นภาวะแทรกซ้อนของโรคเบาหวาน คือมีน้ำตาลในเลือดสูง พบคีโตนในเลือด และเลือดเป็นกรด อัตราการเสียชีวิตสูงโดยเฉพาะผู้ป่วยที่มีโรคร่วมและผู้สูงอายุ การวิจัยนี้จึงมีวัตถุประสงค์ เพื่อศึกษาอุบัติการณ์ การเกิดภาวะคีโตะซีโดซิสในผู้ป่วยน้ำตาลในเลือดสูง ที่เข้ารับบริการในห้องฉุกเฉิน โรงพยาบาลหาดใหญ่ ด้วยวิธีการศึกษาทบทวนเวชระเบียนย้อนหลังผู้ป่วยห้องฉุกเฉิน ปี พ.ศ. 2561 อายุตั้งแต่ 18 ปี ขึ้นไป ถูกวินิจฉัย น้ำตาลในเลือดสูงจากรหัส ICD 10 วิเคราะห์หาอุบัติการณ์ ลักษณะทางคลินิก ผลทางห้องปฏิบัติการ จนถึงการ จำหน่ายผู้ป่วย รายงานผลเป็นจำนวน อัตราส่วน ร้อยละ และค่ามัธยฐาน ผลการศึกษาพบว่า ผู้เข้าเกณฑ์ การศึกษา 269 คน อายุเฉลี่ย 56.2 ปี ร้อยละ 88.8 เป็นเบาหวานชนิดที่ 2 ระดับน้ำตาลในเลือดเฉลี่ย 468.2 มิลลิกรัมต่อเดซิลิตร พบอุบัติการณ์การเกิดคีโตะซีโดซิส ร้อยละ 20.8 ทุกรายรักษาเป็นผู้ป่วยใน โดยนอนที่ หอผู้ป่วยทั่วไป ร้อยละ 40.3 นอนที่หอผู้ป่วยวิกฤติ ร้อยละ 85.7 พบภาวะคีโตะซีโดซิสมากในกลุ่มที่เดิมรักษา ด้วยการฉีดอินซูลิน ร้อยละ 33.1 ผู้ป่วยกลุ่มนี้มีอัตราการหายใจ อัตราชีพจร และโพแทสเซียมในเลือดเพิ่มขึ้น อย่างมีนัยสำคัญ ผู้ป่วยส่วนใหญ่เข้ารับบริการที่ห้องฉุกเฉินเอง (ร้อยละ 51.7) แต่อุบัติการณ์การเกิดคีโตะซีโดซิส พบมากในกลุ่มที่มาถึงด้วยระบบการแพทย์ฉุกเฉิน (ร้อยละ 33.3) โรคร่วมที่พบบ่อยคือ ความดันโลหิตสูง (ร้อยละ 34.41) และมีผลตรวจทางห้องปฏิบัติการเข้าเกณฑ์วินิจฉัยของ American Diabetes Association ปี พ.ศ. 2552 อย่างมีนัยสำคัญทางสถิติ ได้แก่ ระดับน้ำตาลในเลือดสูง ภาวะเลือดเป็นกรดชนิด anion gap กว้าง และตรวจพบ คีโตนในเลือดหรือปัสสาวะ สรุปผล ในผู้ป่วยห้องฉุกเฉินที่มีระดับน้ำตาลในเลือดสูง พบอุบัติการณ์การเกิดภาวะ คีโตะซีโดซิน้อยกว่าการไม่มีคีโตะซีโดซิส แต่จะส่งผลกระทบหากไม่ได้รับการรักษา ดังนั้น จึงยังจำเป็นต้องส่งตรวจ ทางห้องปฏิบัติการในผู้ป่วยน้ำตาลในเลือดสูงทุกรายเพื่อหาว่ามีภาวะคีโตะซีโดซิสหรือไม่ เนื่องจากมีปัจจัยที่ เกี่ยวข้องกับการวินิจฉัยที่หลากหลายจึงยังต้องการการศึกษาต่อยอดหาปัจจัยที่เกี่ยวข้องเพิ่มเติม เพื่อวางแผนทาง การตรวจคัดกรองผู้ป่วยให้มีประสิทธิภาพมากขึ้น นำไปสู่การพัฒนาการดูแลผู้ป่วยและใช้ทรัพยากรให้มีประโยชน์ สูงสุดต่อไป รวมถึงต้องวางแผนปรับปรุงระบบการแพทย์ฉุกเฉินให้ประชาชนเข้าถึงและใช้บริการให้มากขึ้นด้วย

คำสำคัญ: น้ำตาลในเลือดสูง คีโตะซีโดซิส ห้องฉุกเฉิน

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Incidence of diabetic ketoacidosis in the emergency room of Hatyai Hospital

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Abstract

Diabetic ketoacidosis (DKA) is a metabolic complication of diabetes mellitus, characterized by a biochemical triad of hyperglycemia, ketonemia, and metabolic acidosis. This is potentially fatal, especially for the elderly and comorbid patients. The objective of this study was to assess the incidence of DKA in the emergency room at Hatyai Hospital by a retrospective chart review of patients, who were 18-year-old and diagnosed with hyperglycemia or DKA from ICD 10. The analysis covered incidence, clinical features, laboratory results, and the disposition of the patients. The outcomes were reported as the number, ratio, percentage, and median. The results showed that 269 patients were eligible for inclusion in the study. The mean age was 56.2-years-old and most subjects had type 2 diabetes (88.8%) with a mean blood sugar level of 468.2 mg/dL. The DKA incidence was 20.8%, with all of them treated as inpatients and the patients admitted to the general ward (40.3%) and the ICU (85.7%). DKA was the most common found in patients treated with insulin injection (33.1%). This group had a significant increase in respiratory rate, pulse rate and serum potassium. Most of all patients came to the emergency room by themselves (51.7%), but there was a high incidence rate of DKA in patients who came with the emergency medical services (EMS) (33.3%). The most comorbid disease was hypertension (34.41%). All of the DKA patients fulfilled the diagnostic criteria of the 2009 criteria from The American Diabetes Association, including high blood sugar, wide anion gap metabolic acidosis, ketonemia or ketonuria with significant differences in the non-DKA group. In conclusion, the hyperglycaemic patients in the emergency room had a significant incidence of DKA less than simple hyperglycemia, but they would have severe consequences if not treated. Therefore, its still necessary to investigate all patients with hyperglycemia. As there were a variety of factors related to the diagnosis, there still needs to be further studies and to find additional relevant factors to determine hyperglycemic patients that could lead to patient care development and appropriate use of limited resources including the improvement of an emergency medical system to reach more people.

Keywords: hyperglycemia, diabetic ketoacidosis, emergency room

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Introduction

Diabetic ketoacidosis (DKA) is a complication of diabetes mellitus that causes increased risk of death and has been increasingly reported in a number of these patients, especially in African, American, Spanish, and Portuguese countries, with a high mortality rate in developed countries, especially in patients with co-morbidities and the elderly. The main factor of mortality in the elderly has been due to infection, loss of ability to breathe, and ischemic heart disease. The most frequent events were missed insulin injections and diabetes medication taken irregularly.¹

The treatment for DKA consists of fluid therapy, insulin injections, maintaining the serum acid-base, and solving the abnormalities of serum salt-minerals (electrolyte). There is also continuous monitoring of blood sugar and electrolyte levels.² Therefore, most patients should be treated as inpatients for monitoring Insulin and for other medications given by an experienced treatment team. For those patients who have come to the hospital early when the symptoms are mild and can still eat by themselves, the doctors can provide treatment in the emergency room or observation room allowing them to return home 6-12 hours after treatment.³ However, the mortality rate was also associated with underlying disease and poor prognosis in the elderly with severe symptoms (coma), and hypotension.²

Drugs induced DKA include corticosteroids, thiazide, and sympathomimetic

drugs such as dobutamine, terbutaline, antipsychotic drugs, immunosuppressive drugs, cocaine, and cannabis (marijuana).²⁻⁵ Common complications include hypokalemia and hypoglycemia, which is a complication resulting from treatment which, nevertheless, can be prevented with treatment according to a practical guideline and continual monitoring of blood sugar and potassium levels. together with potassium replacement and providing fluids intravenously containing sugar.² Other less common complications include cerebral edema and respiratory failure. The exact cause of brain swelling remains unknown. This condition is more common in children and adolescents and is rarely found in patients older than 28-year-old⁶⁻⁸. While respiratory failure is rare, it is a serious complication with patients suffering from breathing difficulties due to volume overload and hypoxemia after receiving large amounts of fluid therapy even in patients with normal heart function. This condition is often found in patients who are very dehydrated or whose blood sugar levels are very high when they first arrive at the hospital.^{5,6}

Before being discharged home, counseling of the patient is required about the disease, signs and symptoms, prevention, and recognition of early symptoms of DKA.^{5,6} In addition, the patient must have appropriate and regular follow-up appointments with a medical diabetes team, including attention to the patient's mental condition.⁶

Studies in many countries have found that the incidence of DKA is increasing steadily,

even in developed countries. It is an acute complication of diabetes that can be fatal which requires rapid care and continued treatment until the patient returns for follow-up.³

In various studies in the past, it was found that in foreign countries, both developed and developing countries in Europe and America, there have been follow-up studies of the incidence of death indicating that there are many factors contributing to DKA¹¹⁻¹⁵. However, there have been relatively few such studies in Thailand.

The incidence of DKA in Thailand from 2006 to 2010 was 4.67 percent. In the emergency room, Hatyai Hospital, from 2014 to 2017, the number of hyperglycemia's patients steadily decreased, but increased in 2018.

The patients who came to the emergency room by themselves (or brought by their relatives), whether referred from other hospitals, delivered by Emergency Medical Services (EMS), or referred from the outpatient clinic were found to have high blood sugar despite having abnormal symptoms or were asymptomatic.

Definitions

The diagnostic criteria for diabetic ketoacidosis (DKA) are extensive. The American Diabetes Association (ADA) 2009 criteria are plasma glucose > 250 mg/dL, blood gas pH ≤ 7.30 , Serum bicarbonate ≤ 18 mEq/L, anion gap ≥ 10 mEq/L and moderate to high levels of ketones in the blood or urine.²

Other criteria such as the Joint British Diabetes Societies Inpatient Care Group 2013 include plasma glucose ≥ 200 mg/dL, diabetes mellitus, blood pH ≤ 7.3 , serum bicarbonate ≤ 15 mEq/L, serum B-hydroxybutyrate ≥ 3 mmol/L (31 mg/dL) or urinary ketones $\geq 2+$.⁶ The American Association of Clinical Endocrinologists/American College of Endocrinology (AAACE/ACE) 2016 defines DKA as consisting of a blood pH < 7.3 , anion gap > 10 , serum ketone (nitroprusside reaction) positive, serum B-hydroxybutyrate ≥ 3.8 mmol/L (40 mg/dL) or being stuporous or in a coma.¹⁸

Because Hatyai Hospital does not have a laboratory examination for serum B-hydroxybutyrate, we still use the diagnostic criteria for DKA according to the ADA 2009.

Materials and Methods

Study design and sample

The study was a single-center retrospective chart review study. All of the patients were adult, aged more than 18-years-old who were diagnosed with hyperglycemia or DKA from ICD 10 and treated in the emergency room, Hatyai Hospital between January 1 and December 31, 2018. The study was approved by the Ethics Committee for Research on Human Subjects of Hatyai Hospital Protocol number 12/2564 .

Assessment instrument

Sociodemographic and clinical data such as age, gender, religion, weight, height, BMI, and comorbidities, current medication

and how to take it, date of treatment, and laboratory results include DTX, blood sugar, serum ketone, blood gas, electrolyte, last HbA1c result, BUN, creatinine were compiled. Also, channels for receiving services and dispositions were collected from the medical records gathered when patients were admitted. All patients had point-of-care testing (POCT glucose) or DTX > 250 mg/dL. Pregnant patients, referred cases, and patients with incomplete data were excluded.

Statistical Analysis

Data entry into Google form and statistical analyses were performed using the PSPP version 1.4.1-g79ad47. We analyzed for incidence, clinical features, laboratory results, and the disposition of patients. The nominal scale variables were reported as number, ratio, percentage, or comparative analysis, calculated using Pearson's chi-square or Fisher exact test, as appropriate. Ratio scale variables were reported as the mean values of the data being an average or median, as appropriate. Comparative analysis, calculated using Student T-test or One-Way ANOVA was used as appropriate.

Results

From the data collected between January 1 and December 31, 2018, of the 282 patients with hyperglycemia who visited the emergency room, Hatyai Hospital, 13 patients were excluded due to incomplete data. A total of 269 patients were enrolled in the study, 56 of whom were DKA and 213 of non-DKA. The incidence of DKA was 20.8% in 2018, of which 24 (23.5%) in the DKA group and 78 (76.5%) in the non-DKA group were male respectively, 47 (20.3%) and 184 (79.7%) were Buddhists, 33 (23.7%) and 106 (76.3%) were brought to the emergency room by relatives or by themselves respectively, 7 (8.5%) and 75 (91.5%) were referred from other departments, 40 (16.7%) and 199 (83.3%) had previous diagnoses of type 2 diabetes, 29 (32.6%) and 60 (67.4%) were treated with insulin injections, 6 (7%) and 80 (93%) received oral medication, 30 (22.4%) and 104 (77.6%) were followed up by appointment, 26 (19.3%) and 109 (80.7%) were lost to follow up. Fifteen (14.2) and 91 (85.8%) had hypertension, 8 (25%) and 24 (75%) had infection or sepsis, 50 (40.2%) and 74 (59.7 %) were admitted, and all DKA's patients were treated as inpatients. Six patients (85.7%) were treated in intensive care units (ICU). The data is shown in Table 1 and Table 3.

Table 1 Demographic and clinical characteristics of patients

	DKA N = 56	Non-DKA N = 213	Total N = 269	p-value
Male, n (%)	24 (23.5)	78 (76.5)	102 (37.92)	0.392
Religion, n (%)				0.249
Buddhists	47 (20.3)	184 (79.7)	231 (85.9)	
Muslim	7 (20.6)	27 (79.4)	34 (12.6)	
Other	1 (100)	0 (0.0)	1 (0.4)	
N/A	1 (33.3)	2 (66.7)	3 (1.1)	
Arrived at ER by, n (%)				0.002
Themselves or relative	33 (23.7)	106 (76.3)	139 (51.7)	
Referred from outpatient clinic	7 (8.5)	75 (91.5)	82 (30.5)	
EMS	16 (33.3)	32 (66.7)	48 (17.8)	
Type of DM, n (%)				< 0.001
Type 1	16 (53.3)	14 (46.7)	30 (11.2)	
Type 2	40 (16.7)	199 (83.3)	239 (88.8)	
Current treatment, n (%)				< 0.001
Diet control	12 (21.1)	45 (78.9)	57 (21.2)	
Oral medication	6 (7)	80 (93)	86 (32.0)	
Insulin injection	29 (32.6)	60 (67.4)	89 (33.1)	
All of above	9 (24.3)	28 (75.7)	37 (13.8)	
Follow up status, n (%)				0.527
Regular follow up	30 (22.4)	104 (77.6)	134 (49.8)	
Lost to follow up	26 (19.3)	109 (80.7)	135 (50.2)	
Disposition, n (%)				< 0.001
Admit to ward	50 (40.3)	74 (59.7)	124 (46.1)	
Admit to ICU	6 (85.7)	1 (14.3)	7 (2.6)	
Discharge home	0 (0.0)	138 (100.0)	138 (51.3)	

Table 2 Continuity variables of patients classified by diagnosis of DKA

Continuous variable	DKA N = 56	Non-DKA N = 213	Total N = 269	p-value
Age, mean (SD), year	47.8 (15.5)	58.4 (15.2)	56.2 (15.8)	< 0.001
Vital sign, median (IQR)				
Body temperature, °C	37 (36.6,37.7)	36.9 (36.6,37.2)	36.9 (36.6,37.4)	0.195
Systolic blood pressure, mmHg	137.5 (122,157)	145 (126,169)	144.5 (124,167)	0.257
Diastolic blood pressure, mmHg	83 (68,92)	79 (70,95)	80 (70,94)	0.584
Respiratory rate, /min	24 (22,32)	22 (20,24)	22 (22,26)	< 0.001
Pulse rate, /min	107 (97,116)	94 (81,109)	98.5 (84.8,114)	< 0.001
O ₂ saturation, %	98 (97,99)	98 (96,99)	98 (96.8,99.0)	0.633
BMI*, median (IQR), kg/m ²	21.6 (19.7,25.8)	23.7 (20.6,27.4)	23.1 (20.3,26.9)	0.050
Length of stay in ED**, median, minute	160 (120,220)	155 (120.0,207.5)	155 (120,210)	0.519

* BMI = body mass index

** ED = Emergency Department (Emergency room)

We classified patients into two groups: DKA and non-DKA. The mean age was 47.8-year-old (15.5%) and 58.4-year-old (15.2%) respectively. They had a body temperature of 37 °C (36.6,37.7) and 36.9 °C (36.6,37.2); systolic BP was 138 mmHg (122,159) and 145 mmHg (126,169). Diastolic BP was 83 (68,92) mmHg and 79 mmHg (70,95). Respiration

rates were 24/min (22,32) and 22/min (20,24). The pulse rates were 107/min (97,116) and 94/min (81,109). O₂ saturation were 98% (97, 99) and 98% (96,99). BMI were 21.6 kg/m² (19.7,25.8) and 23.7 kg/m² (20.6,27.4). The length of stay in ED were 160 minutes (120,220) and 155 minutes (120.0,207.5), respectively, as shown in Table 2.

Table 3 Comorbid diseases of patients with high blood sugar

Grouping variable	DKA N = 56	Non-DKA N = 213	Total N = 269	p-value
Underlying disease, n (%)	28 (16.6)	141 (83.4)	169 (62.8)	0.026
Dyslipidemia	9 (12.9)	61 (87.1)	70 (26.0)	0.056
Hypertension	15 (14.2)	91 (85.8)	106 (39.4)	0.030
Gastrointestinal disease	2 (10.0)	18 (90.0)	20 (7.4)	0.266
Renal disease	6 (15.0)	34 (85.0)	40 (14.9)	0.326
Cerebrovascular disease	5 (22.7)	17 (77.3)	22 (8.2)	0.818
Cardiovascular disease	2 (10.0)	18 (90.0)	20 (7.4)	0.266
Cancer	1 (11.1)	8 (88.9)	9 (3.3)	0.690
Hyperthyroidism	1 (33.3)	2 (66.7)	3 (1.1)	0.505
Other	1 (5.6)	17 (94.4)	18 (6.7)	0.134
Infection/sepsis in same visit	8 (25.0)	24 (75.0)	32 (11.9)	0.535

Table 4 Laboratory result of hyperglycemic patients

Continuous variable	DKA N = 56	Non-DKA N = 213	Total N = 269	p-value
Plasma glucose, mean (SD), mg/dL	548.5 (164.1)	446.8 (152.2)	468.2 (158.0)	< 0.001
HbA1c, mean (SD), mg/dL	11.7 (3.3)	10.9 (2.9)	11.0 (3.0)	0.152
Serum or urine ketone, n (%)				< 0.001
Negative	5 (3.6)	134 (96.4)	139 (51.7)	
Positive	50 (54.9)	41 (45.1)	91 (33.8)	
No result	1 (2.6)	38 (97.4)	39 (14.5)	
Electrolyte, mean (SD), mmol/L				
Sodium (Na)	130.2 (18.7)	132.0 (10.5)	131.6 (12.7)	0.277
Potassium (K)	5.2 (0.9)	4.5 (0.7)	4.6 (0.8)	< 0.001
Chloride (Cl)	95.7 (6.6)	96.9 (7.7)	96.7 (7.5)	0.078
Bicarbonate (CO ₂), median (IQR), mmol/L				
From venous result	12 (7,17)	24 (21,26)	22 (18,25)	< 0.001
From blood gas result	10.1 (6.3,15.1)	21.6 (19.0,24.9)	20 (15.4,24.0)	< 0.001

Table 4 (Con.)

Continuous variable	DKA N = 56	Non-DKA N = 213	Total N = 269	p-value
pH, median (IQR)	7.3 (7.1,7.3)	7.4 (7.4,7.5)	7.4 (7.3,7.4)	< 0.001
BUN, median (IQR), mg/dL	24 (18,39)	17 (13,31)	19 (13,32)	0.001
Creatinine, median (IQR), mg/dL	1.0 (0.7,1.5)	0.9 (0.6,1.3)	0.9 (0.6,1.4)	0.390
Anion gap, median (IQR), mEq/L	31.2 (26.1,34.1)	15.6 (12.4,18.5)	16.7 (13.0,22.6)	< 0.001

Table 4 shows laboratory result of both groups, the DKA and the non-DKA. The mean plasma glucose level or DTX/POCT glucose were 548.5 mg/dL (164.1) and 446.8 mg/dL (152.2). The mean HbA1c were 11.7 mg/dL (3.3) and 10.9 mg/dL (2.9). Positive serum or urine ketone were 5 (54.9%) and 41 (45.1%). The mean sodium were 130.2 mmol/L and 132 mmol/L. The mean potassium were 5.2 mmol/L and 4.5 mmol/L. The mean venous bicarbonate were 12 mmol/L and 24 mmol/L. The median of blood pH were 7.3 and 7.4. The median of anion gap were 31.2 mEq/L and 15.6 mEq/L.

Discussion

This study showed the incidence of DKA in the emergency room was 20.8%. It was found to be quite high compared with the study of Anthanont P. et al.¹⁶ that showed the incidence of DKA was 7.46% in the population of Thammasat Hospital.

The characteristics of hyperglycemic patients with DKA consisted of age, gender, and type of diabetes. It is consistent with the study of Anthanont P.¹⁶ et al. that studied incidence of hyperglycemic creisis in all diabetic patients in 2006 - 2010, but our study

resulted with a mean age difference from the study of Adit A et al.¹⁷, which is an international study of the United States. Regarding DKA admissions to the emergency room between 1993 and 2003, the study of Adit A et al., the age range of most patients with DKA was 30-39-years-old, which was less than our study and the study of Anthanont P. el al.¹⁶

Type 2 diabetes patients outnumbered type 1 diabetes consistently with the adult diabetes survey, which found that more than 90% of diabetes patients had type 2 diabetes¹⁹. It was found that most of the type 1 diabetes patients had DKA, while most of the type 2 diabetes did not have DKA. And in both groups, there was no significant difference in BMI ($p = 0.050$).

Most DKA patients are treated with injected insulin. Patients who needed injected insulin were all patients with type 1 diabetes and type 2 diabetes who had HbA1c greater than or equal to 10%²⁰, consistent with our study that the mean HbA1c was 11% in all diabetics and 11.7% in the DKA group and even those in the non-DKA group (10.9%). It may be concluded that hyperglycemia patients in the emergency room, Hatyai Hospital were poorly controlled.

In addition, the study also found that patients who were followed up by appointment or who were lost to follow-up had no significant difference for incidence of DKA. However, for continued and effective treatment, physicians may need to modify their advice to patients of their knowledge of the disease, treatment methods, and to verify the understanding and accuracy of information and treatments with the patients in order to make patients realize the importance of treatment and to be aware of complications that can occur in diabetic patients. When considering HbA1c in the DKA group was higher than the non-DKA group, perhaps the patients who came for follow-up had poor diet control or used the wrong medication causing complications of hyperglycemia.

One of the DKA patients did not receive a ketone test. After reviewing medical records, it was found that this patient had DTX > 250 mg/dL; after blood gas testing, it was found that metabolic acidosis met the criteria for a diagnosis of DKA. Therefore, he was admitted to the general medicine ward after which there was an additional ketone test later by an internist. This study presents the incidence of diagnosed DKA in only the emergency room, but not recorded data during admission or follow-up. Therefore, the patient's ketone values were recorded as no data or not being examined in the emergency room.

Common co-morbidities in DKA were hypertension, followed by dyslipidemia and the infection or sepsis that occurred during

visits. This is consistent with study of Anthanont P. et al.¹⁶ that found that sepsis is a factor for DTK. But in other comorbid diseases, no other studies indicated this. As for the laboratory tests, results followed the ADA³ diagnostic criteria, and all patients diagnosed with DKA were treated as inpatients.

In the study of Adit A et al.¹⁷, most of the patients were inpatients, but some of the patients were able to go home and continue outpatient treatment. Considering the cause, maybe the patients came to the hospital early since the symptoms were few and they could feed themselves. Doctors could provide treatment in the emergency room or observation room, and then discharge the patient home within 6-12 hours after the treatment². This is different from the management in the emergency room of Hatyai Hospital. which has limited space and no observation room; therefore, they are unable to continuously monitor and closely observe the patient. This has made it necessary to admit all patients diagnosed with DKA.

Most of the DKA patients came to the emergency room by themselves (or brought by their relatives), were delivered by Emergency Medical Services (EMS), or were referred from the outpatient department (OPD). The incidence of DKA was significantly lower among patients from OPD than among patients from other channels. And 91.5% of the OPD patients were non-DKA, while another 8.5% were diagnosed with DKA, which is clinically important and requires urgent treatment. When considering the characteristics of early

vital signs in patients with DKA, it was found that their respiratory and pulse rates were higher than those with non-DKA, and higher than normal as well. This demonstrates difficulty in screening patients who attend outpatient or emergency rooms, causing delays in diagnosis and treatment. On the other hand, more than 91.5% of the patients who were referred from the OPD with high blood sugar problems were non-DKA causing patients to waste time waiting unnecessarily for fluid replacement or to miss an appointment to see a specialist on that day.

However, the current study by Anthanont P. et al.¹⁶ was to study the incidence of hyperglycemia in all diabetic patients conducted in Thailand between 2006 – 2010 in which they found a hyperglycemic crisis which was 7.46% and had a DKA of 4.67%. There had been no previous studies of hyperglycemia incidence in emergency rooms in Thailand. Therefore, we are interested in further researching this study to provide information on Thai patients with DKA in the emergency room and as a basis for further research.

Limitation

The first limitation was that this was a retrospective study, so some data was incomplete and grouping bias was possible. Second, the sample size was small, which caused a limit to the analysis of factors affecting the occurrence of DKA in hyperglycemia patients. Thirdly, information about the symptoms that caused hyperglycemia

patients to come to the emergency room had not been taken into consideration during the data collection process. Fourth, Hatyai Hospital was unable to test serum B-hydroxybutyrate, but still used the test of serum ketone, which is an old method; therefore, there was a limitation in interpretation. Fifth, the data was collected from a single center.

Conclusion

The incidence of DKA in hyperglycemia patients in the emergency room was less common than simple hyperglycemia (non-DKA) regardless of how services were received. Nevertheless, this study was just the beginning. More studies are needed to search for the relevant factors, including cost-effectiveness, workload of the medical team, etc., to improve quality and safety service.

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