



## Research Article

# Diabetic Emergency: Diabetic ketoacidosis, hyperglycemic hyperosmolar state, euglycemic diabetic ketoacidosis and hypoglycemia

Author (s): Hadi Saifullah \*<sup>1</sup>

<sup>1</sup>Department of Internal Medicine, Nangarhar University, Jalalabad city, Nangarhar Province, Afghanistan

Corresponding Author: \*Hadi Saifullah

DOI: <https://doi.org/10.5281/zenodo.10474628>

Abstract	Manuscript Information
<p><b>Background:</b> Diabetic Ketoacidosis (DKA), hyperosmolar hyperglycemic states (HHS), and hypoglycemia are the most serious and fatal complications of diabetes if their diagnosis and treatment are not done on time. They will cause comas and eventually death. Dehydration is present in both DKA and HHS, but ketosis and metabolic acidosis are present only in DKA. Our aim is to find out about DKA, HHS, EDKA and hypoglycemia in diabetes mellitus patients in the Nangarhar University Teaching Hospital Medical Ward.</p> <p><b>Methods and Materials:</b> This cross-sectional retrospective study was conducted with 275 in patients with diabetes mellitus DM1 and DM2 during 2023-2024.in the Nangarhar university teaching hospital medical ward. We studied acute complications of DM such as DKA, HHS, EDKA and Hypoglycemia in DM1 and DM2 patients and in both sex males and females. Biochemical tests such as blood sugar, urine ketone bodies, urine and blood tests were performed free of charge in the hospital laboratory. During this period, we found all the files of the patients who were hospitalized under diabetes diagnosis and laboratory tests, and we compiled and analyzed all the figures in the Excel page. We separated all the patients with diabetes according to gender and age. In this research, those who were over 18 years old are included. The fully automated clinical chemistry analyzer from micro lab, model 300, was used to measure biochemical parameters. IBM SPSS version 26 statistical software was used to analyses the data.</p> <p><b>Result:</b> In 2023–2024, 275 diabetic patients were admitted to the university teaching hospital, of whom 67% (184) were female and 33% (91) were male. Of these patients, 78% (213) were not DKA, and 22% (62) were DKA. HHS was negative in 100% of diabetes patients. EDKA was negative in 100% of patients. Hypoglycemia was positive in 16% (44) of diabetes patients. KA was positive in 24.18% of men and negative in 75.82% of male patients. DKA was positive in 21.62% of female patients and negative in 78.38% of female patients. Hypoglycemia was positive for diabetes in 27.27% (12) of male patients, and 72.73% (32) of female patients were positive for diabetes. Hypoglycemia was positive in 11.27% (33) of DM2 patients, of which 7.27% (22) were females and 4% (11%) were males. Hypoglycemia was positive in 4.72% (11) of DM1 patients, of which 2.90% (8) were females and 1.81% (3) were males. The number of DM1 patients was 7.63% (21). Among DM1 patients, 2.18% (6) had DKA, of which 1.09% (3) were females and 1.09% (3) were males. The number of DM2 patients was 92.30% (254). Among DM2 patients, 20.36% (56) had DKA, of which 14.91% (41) were females and 5.45% (15) were males</p> <p><b>Conclusion:</b> In this research, it can be seen that in the emergency complications of diabetes, the occurrences of DKA and hypoglycemia were high, and the occurrences of HHS and EDKA were not seen, and the occurrences of the diabetes mellitus was high in women, similarly, the occurrences of type 2 DM was high compared to DM1.</p>	<p><b>How to Cite this Manuscript</b></p> <p>Hadi Saifullah. Diabetic Emergency: Diabetic ketoacidosis, hyperglycemic hyperosmolar state, euglycemic diabetic ketoacidosis and hypoglycemia. International Journal of Contemporary Research in Multidisciplinary. 2024; 3(1):31-37.</p> <ul style="list-style-type: none"> <li>▪ ISSN No: 2583-7397</li> <li>▪ Received: 03-12-2023</li> <li>▪ Accepted: 05-01-2024</li> <li>▪ Published: 09-01-2024</li> <li>▪ IJCRM:3(1);2024:31-37</li> <li>▪ ©2024, All Rights Reserved</li> <li>▪ Plagiarism Checked: Yes</li> <li>▪ Peer Review Process: Yes</li> </ul>

**Keyword:** Diabetes mellitus; Hyperglycemic hyperosmolar nonketotic state; Diabetic Ketoacidosis, euglycemic DKA. hypoglycemia.

## 1. Introduction

When your blood sugar (glucose) level is too high, you develop diabetes. It appears when your body is not reacting to the effects of insulin appropriately or when your pancreas produces too little or no insulin at all. People of all ages are impacted by diabetes. Diabetes can be managed with medicine and/or lifestyle modifications. The majority of types of diabetes are chronic, meaning they last a lifetime. Below are a few signs of both type 1 and type 2 diabetes: I'm becoming thirstier than normal. Urination is frequent. Losing fat without making an effort. Ketones are present in the urine. When there is insufficient insulin accessible, muscle and fat break down, producing ketones as an outcome. Feeling feeble and worn out. Getting agitated or experiencing other mood swings having eyesight problems. Having wounds that heal slowly and developing multiple infections, including skin, gum, and vaginal infections. The problem that forced us to conduct such research was that diabetes patients refer to the university teaching hospital, and most of them have severe and fatal complications such as DKA, HHS, and hypoglycemia. In addition, there is no such information in the database, so we felt it was necessary to do this research. The importance of this research is that the complications of diabetes can be diagnosed and taken care of early, the patient will get well soon, and the progression of the disease and the death of the patient will be prevented. The benefit of such research is that, on the one hand, the combination of diabetes can be diagnosed and treated early, and on the other hand, a regular diagnosis and treatment plan will be introduced to the hospital for such patients. Diabetes is a group of metabolic disorders characterized by hyperglycemia, which occurs because of insulin secretion deficiency, insulin effect deficiency, or both. Diabetes causes insufficiency of the kidney, retinal disorders, and lower peripheral wounds. Diabetes causes two types of complications: acute and chronic complications. Acute complications include DKA, HHS, hypoglycemia, (Bedaso, A and Oltaye, 2019) [6]. There are two types of diabetes: type 1 occurs due to beta-cell destruction, and resistance to insulin causes type 2. Type 1 diabetes constitutes 5–10% of diabetes, and type 2 diabetes constitutes 90–95% of diabetes. Diabetes and its complications cause premature death, which is the main cause of death in patients with cardiovascular diseases. (Bedaso, A and Oltaye, 2019) [6]. Acute and long-term effects of diabetes mellitus include diabetic ketoacidosis (DKA), hyperosmolar hyperglycemia, and hypoglycemia during treatment. One of the most serious acute effects of DM is diabetic ketoacidosis (DKA). When stored triglycerides turn to fatty acids, which act as other sources of fuel, ketoacidosis occurs. Forgotten insulin doses, illnesses, infections, and untreated or uncontrolled type 2 diabetes are among the most frequent causes of DKA. Hyperglycemia, dehydration, electrolyte loss, and acidosis are the main clinical signs of DKA. People with type 1 diabetes frequently develop diabetic ketoacidosis (DKA). However, those who have type 2 diabetes also run the risk of developing diabetic ketoacidosis. In 2013, it was predicted that 19.8 million people with disabilities, or 4.9%, in Africa had diabetes. (Bedaso, A and Oltaye, 2019) [6]. Diabetic ketoacidosis (DKA), Hyperglycemic

hyperosmolar state (HHS) and hypoglycemia are the serious and fatal complications of diabetes, if it is not diagnosed and treated early, it will cause the patient to die. In both diseases, the blood sugar level of the patients is high, and the patients are dehydrated. In DKA, there is metabolic acidosis and dehydration while in HHS, the only patients who have. In DKA, the incidence of death is less than 1%, while in HHS; it is more than 10%. Hypoglycemia is a deadly disease and a complication of antidiabetic drugs, but if not diagnosed and treated early, many people become ill (Umierrez, G., and Korytkowski, M, 2016) [1]. Mortality in DKA has been reduced for many years because its pathophysiology has been understood. Mortality in hyperglycemic hyperosmolar states (HHS) is high because the patient is old and it is not diagnosed early. (Kitabchi, A. E and Nyenwe, E. A, 2006) [2]. DKA and HHS are found in both types of diabetes (type 1 and type 2). DKA is characterized by hyperglycemia, ketone body production, and metabolic acidosis. The aggravating factors are infections and forgetting to take insulin. In the last 20 years, the death rate of DKA has not decreased and is 3.4%–4.6%, while the death rate in HHS is 15%. HHS is characterized by high blood sugar, dehydration, hyperactive osmolality, and little or no ketosis. Both pathophysiology and mechanism are different, and the pathophysiology and mechanisms of both are different. In these disease, insulin is low and counter regulatory hormones such as glucagon, catecholamine's, cortisol, and growth hormone are increased. In DKA, there is an absolute lack of insulin and catecholamine activity is increased; as a result, lipolysis increases, fatty acid production increases, and beta-oxidation and ketogenesis increase. In HHS, the residual beta cells prevent lipolysis, and there is hyperglycemia. Patients over 65 years old, as well as those who have coma and hypotension, have much worse prognoses for both diseases. Intravenous insulin, fluid replacement, and concurrent treatment of the triggering causes all form the cornerstones of therapy. The frequency of hospital admissions resulting from DKA and HHS, which are, in the majority of cases, preventable, may be reduced with improved patient education and the use of strategies like home glucose and ketone monitoring. (Gouni-Berthold, Krone and W, 2006, I) [3]. The prognosis of both diseases after the age of 65, coma and low blood pressure is bad. The basic treatment of both is the infusion of fluids, insulin, and the treatment of trigger factors. When the patient recovers, he should be taught about his illness and how to measure blood sugar and blood ketone levels at home. (Gouni-Berthold, I and Krone, W, 2006) [3]. DKA is found in type 1 diabetes patients and young people, and HHS is found in elderly patients with type 2 diabetes. Sometimes both DKA and HHS are present together. Both diseases are caused by insulinopenia, and both are severe cases of hyperglycemia. If both are diagnosed and treated early, the results of the disease are good. The basic treatment for both is rehydration, insulin therapy, electrolyte replacement, and intensifying factor treatment. (Fayfman, M and Pasquel, F, 2017) [4]. Diabetic ketoacidosis (DKA) and hyperglycemic hyperosmolar state (HHS) are serious complications of hyperglycemia. In 1921, the discovery of insulin brought about positive changes in the lives

of diabetes patients.(Maletkovic, J and Drexler, A, 2013) [5]. Our goal is to understand more about hypoglycemia, EDKA, DKA, and HHS in patients with diabetes mellitus in the medical ward at Nangarhar University Teaching Hospital.

**2. Methods and Materials**

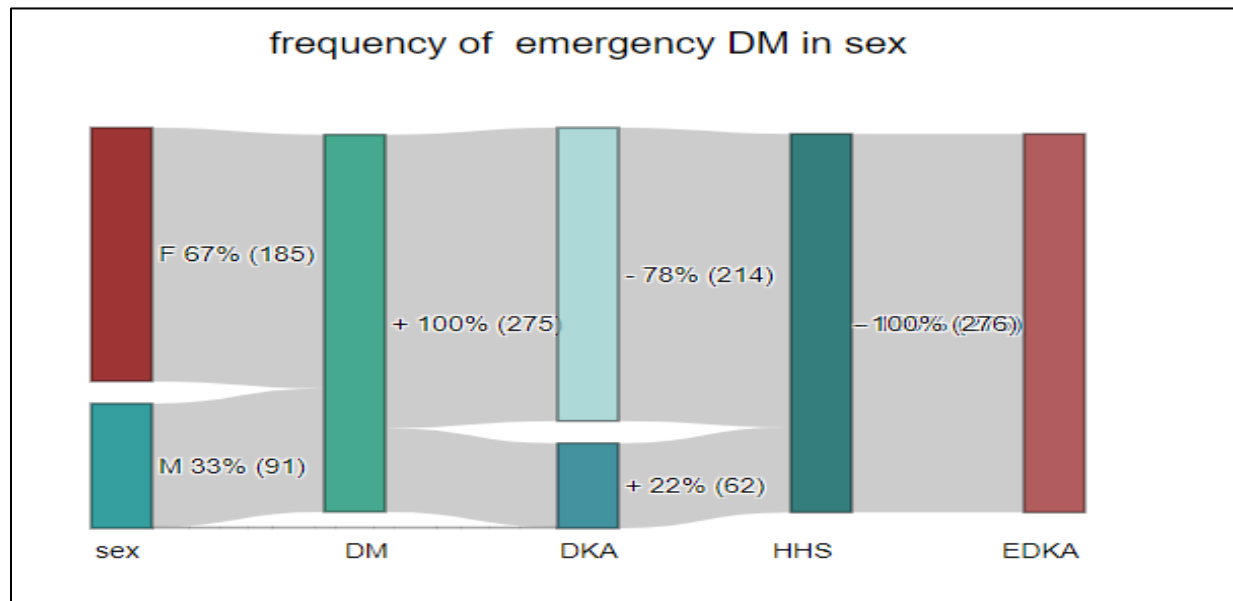
This cross-sectional retrospective study was conducted with 275 in patients with diabetes mellitus DM1 and DM2 during 2023-2024.in the Nangarhar university teaching hospital medical ward. we studied acute complications of DM such as DKA, HHS, EDKA and Hypoglycemia in DM1 and DM2 patients and also in both sex males and females. Biochemical tests such as blood sugar, urine ketone bodies, urine and blood tests were performed free of charge in the hospital laboratory. During this period, we found all the files of the patients who were hospitalized under diabetes diagnosis and laboratory tests, and we compiled and analyzed all the figures in the Excel page. We separated all the patients with diabetes according to gender and age. In this research, those who were over 18 years old are included. The fully automated clinical chemistry analyzer from micro lab, model 300, was used to measure biochemical parameters. IBM SPSS version 26 statistical software was used to analyses the data.

**3. Result**

In 2023–2024, 275 diabetic patients were admitted to the university teaching hospital, of whom 67% (184) were female and 33% (91) were male. Of these patients, 78% (213) were not DKA, and 22% (62) were DKA. HHS was negative in 100% of diabetes patients. EDKA was negative in 100% of patients. Hypoglycemia was positive in 16% (44) of diabetes patients (table 2and fig 1). DKA was positive in 24.18% of men and negative in 75.82% of male patients. DKA was positive in 21.62% of female patients and negative in 78.38% of female patients. (Table 3 and fig 2). The number of DM1 patients was 7.63% (21). Among DM1 patients, 2.18% (6) had DKA, of which 1.09% (3) were females and 1.09% (3) were males. The number of DM2 patients was 92.30% (254). Among DM2 patients, 20.36% (56) had DKA, of which 14.91% (41) were females and 5.45% (15) were males. (Table 3, 4). Hypoglycemia was positive for diabetes in 27.27% (12) of male patients, and 72.73% (32) of female patients were positive for diabetes. (Fig 3). Hypoglycemia was positive in 11.27% (33) of DM2 patients, of which 7.27% (22) were females and 4% (11%) were males. Hypoglycemia was positive in 4.72% (11) of DM1 patients, of which 2.90% (8) were females and 1.81% (3) were males. (Table 5, 6).

**Table 1:** Shows the Statistic age of diabetic patients.

Statistics		
Age		
N	Valid	275
	Missing	0
	Mean	55.99
	Median	57.50
	Mode	60
	Std. Deviation	13.224
	Minimum	13
	Maximum	100

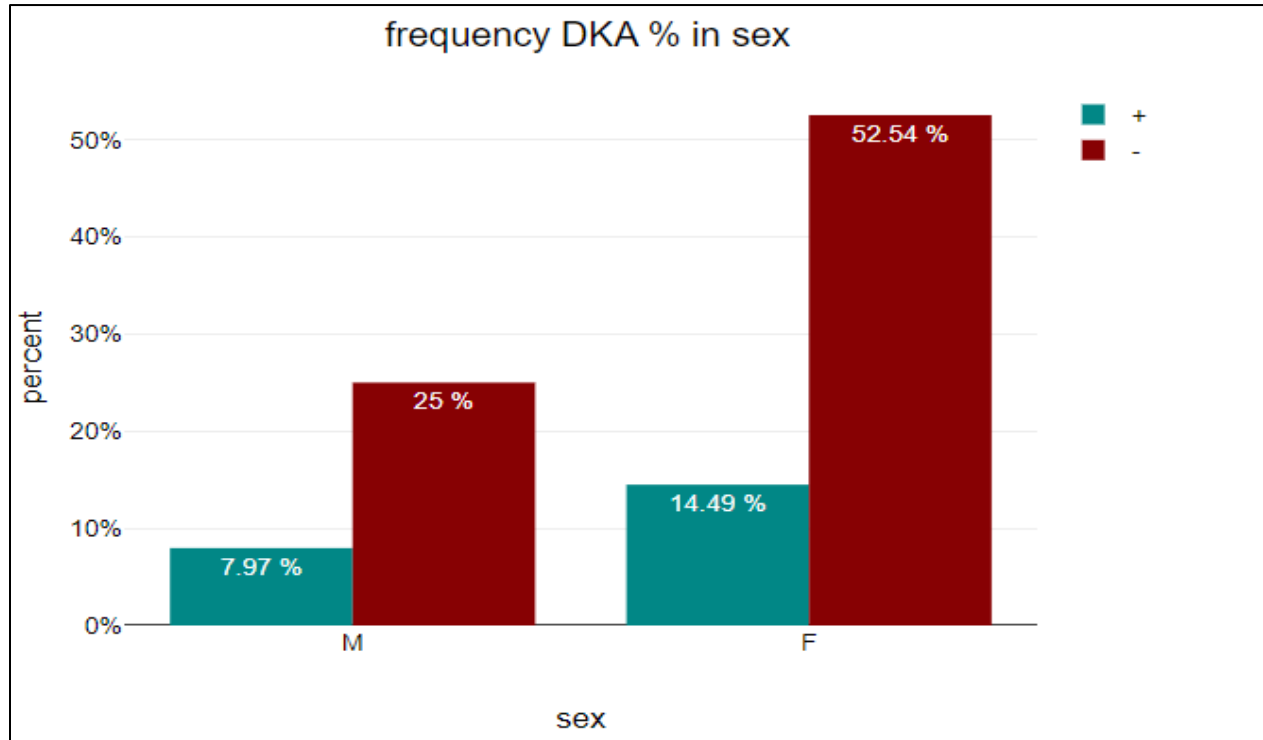


**Fig 1:** Shows the frequency of emergency complications of diabetes mellitus in both sex

**Table 2:** Acute Complications of Diabetes Mellitus

Complications	No of positive patients	No of negative patients
DKA	22%(62)	78%(213)
HHS	0%	100%(275)
EDKA	0%	100%(275)
HYPOGLYCEMIA	16%(44)	84%(231)

**DKA:** Diabetic Ketoacidosis. **HHS:** Hyperosmolar Hyperglycemic State. **EDKA:** Euglycemic DKA



**Fig 2:** shows the prevalence of DKA in both sex.

**Table 3:** prevalence of DKA according to age group and sex

Age group	Number	DKA+	Sex	
			F	M
20-40	30	8	4	4
41-60	170	40	28	12
>60	75	14	10	4
TOTAL	275	62	42	20

**Table 4:** prevalence of DKA in both types of DM

Type of DM	No of patients	DKA	Female DKA	Male DKA
DM1	7.63%(21)	2.18%(6)	1.09%(3)	1.09%(3)
DM2	92.30%(254)	20.36%(56)	14.91%(41)	5.45%(15)
Total	99.93%(275)	22.54%(62)	16%(44)	6.54%(18)

Table 4: Frequency of age of diabetes mellitus patients

		Frequencies of age			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	13	1	.4	.4	.4
	15	1	.4	.4	.7
	16	1	.4	.4	1.1
	22	1	.4	.4	1.4
	25	1	.4	.4	1.8
	26	3	1.1	1.1	2.9
	27	1	.4	.4	3.3
	28	2	.7	.7	4.0
	35	5	1.8	1.8	5.8
	36	2	.7	.7	6.5
	38	3	1.1	1.1	7.6
	40	10	3.6	3.6	11.2
	42	1	.4	.4	11.6
	43	3	1.1	1.1	12.7
	44	1	.4	.4	13.0
	45	29	10.5	10.5	23.6
	46	1	.4	.4	23.9
	47	2	.7	.7	24.6
	48	4	1.4	1.4	26.1
	49	1	.4	.4	26.4
	50	34	12.3	12.3	38.8
	51	1	.4	.4	39.1
	52	1	.4	.4	39.5
	53	3	1.1	1.1	40.6
	54	1	.4	.4	40.9
	55	23	8.3	8.3	49.3
	56	1	.4	.4	49.6
	57	1	.4	.4	50.0
	58	3	1.1	1.1	51.1
	60	59	21.4	21.4	72.5
	62	2	.7	.7	73.2
	63	1	.4	.4	73.6
	65	19	6.9	6.9	80.4
	66	1	.4	.4	80.8
	67	2	.7	.7	81.5
	68	2	.7	.7	82.2
	69	1	.4	.4	82.6
	70	23	8.3	8.3	90.9
	72	1	.4	.4	91.3
	73	1	.4	.4	91.7
75	7	2.5	2.5	94.2	
76	1	.4	.4	94.6	
80	10	3.6	3.6	98.2	
85	2	.7	.7	98.9	
88	1	.4	.4	99.3	
90	1	.4	.4	99.6	
100	1	.4	.4	100.0	
	Total	276	100.0	100.0	

Fig 3: Shows the prevalence of hypoglycemia in diabetes mellitus

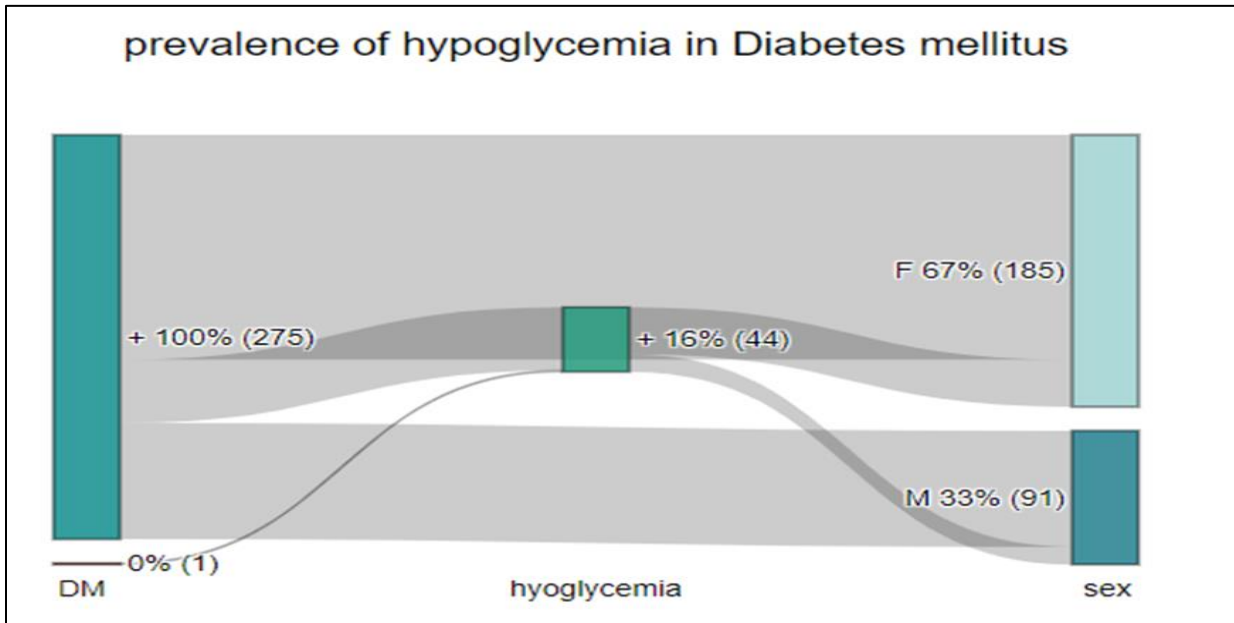


Table 5: Age group of hypoglycemia in diabetes mellitus

Age of patients	
<40	4.72%(13)
≥40	11.27%(31)
Total	16%(44)

Table 6: prevalence of hypoglycemia in diabetes mellitus

Diabetes mellitus	Hypoglycemia		
	No of patients	F	M
DM1	4.72%(11)	2.90%(8)	1.81%(3)
MD2	11.27%(33)	7.27%(22)	4%(11)
Total	44	30	14

DM1: Diabetes mellitus type-1, DM2: Diabetes Mellitus type-2

#### 4. Discussion

Because there are many cases of diabetes in the university teaching hospital, there is no information about emergency complications, so we wanted to do research about the emergency and fatal cases of diabetes. In this way, we found the emergency cases of diabetes, which are explained in detail because of this research. If these urgent and deadly events of the disease are not taken care of urgently, it will cause the death of the patient. In the 275 diabetes patients who were under our study during this period, there were both types of diabetes, namely DM1 and DM2. The number of DM2 was 92.30%, the number of women was 67%, the number of DKA was 22%, HHS and EDKA were none, and hypoglycemia was 16%. The nutritionist, diabetes care and education expert, and primary care physician, among others, are members of your diabetes care team who may support you as you navigate the fundamentals of diabetes care. Nonetheless, you are responsible for managing your illness. Study up on diabetes as much as possible. Incorporate regular exercise and a nutritious diet into your daily schedule. Keep your weight within healthy limits. As

directed by your healthcare practitioner, keep an eye on your blood sugar levels and take appropriate action to control them. As prescribed by your healthcare professional, take your prescriptions. When assistance is needed, ask the members of your diabetes care team. If you currently smoke, try not to smoke or stop. The risk of type 2 diabetes and other complications from the disease is increased by smoking. Similar to diabetes, blood vessel damage can be caused by high blood pressure. Diabetes makes the harm caused by high cholesterol even more severe and quicker. Collectively, these disorders may result in a heart attack, stroke, or other potentially fatal illnesses. High blood pressure and cholesterol can be effectively managed by eating a balanced diet low in fat and salt, avoiding from alcohol, and engaging in regular exercise. If needed, your physician may require you to take prescription drugs. According to an Ethiopian study, the prevalence of DKA among individuals suffering from acute complications from diabetes was 68.3% in Dessie and 71% in Jimma, respectively. (Bedaso, A and Oltaye, 2019)<sup>[6]</sup>. Among the 71 patients with DKA, 19 (26.7%) had type 1 diabetes, and 52 (73.3%) had type 2 diabetes (Shahid W, October 04, 2020)<sup>[7]</sup>. In our study, 195 patients were included; 78 (40%) of them had DKA, 55 (28.2%) had type 1 diabetes, and 23 (11.8%) had type 2 diabetes. 14% had hypoglycemia, and 9% had a hyperosmolar, hyperglycemic state (Bedaso, A.,2019)<sup>[6]</sup>. In this research, 60.7% were male, 39.3% were female, 16.6% had type 1 diabetes, and 84.4% had type 2 diabetes. In acute complications of diabetes, hyperglycemia was 71.27%, DKA was 32.12.2percentage, and hypoglycemia was 21.8 % (Jasper, U. S., 2014)<sup>[8]</sup>. 1211 hyperglycemic crisis patients were hospitalized, among which 465 (38%) had only DKA, 412 (35%) had only HHS, and 325 (27%) had a mixture of DKA and HHS (Pasquel, F. J., 2020)<sup>[9]</sup>.



## 5. Conclusion

This study shows that among emergency complications of diabetes, there was a high incidence of DKA and HYPOGLYCEMIA, a low incidence of HHS and EDKA, and a high incidence of diabetes mellitus in women. In addition, there was a higher incidence of type 2 diabetes than DM1.

## 6. Acknowledgement

I would like to express my deep gratitude to the laboratory technicians to examination blood sugar.

## 7. Conflict of Interest

There is no conflicting opinions.

## 8. Funding

There was no funding of any organization for performing this research.

## 9. Authors Contributions

In this research, there is only one author; Dr. Saifullah Hadi did all the research work.

## References

1. Umpierrez G, Korytkowski M. Diabetic emergencies—ketoacidosis, hyperglycaemic hyperosmolar state and hypoglycaemia. *Nature Reviews Endocrinology*. 2016 Apr;12(4):222-232. <https://pubmed.ncbi.nlm.nih.gov/26893262/>
2. Kitabchi AE, Nyenwe EA. Hyperglycemic crises in diabetes mellitus: diabetic ketoacidosis and hyperglycemic hyperosmolar state. *Endocrinology and Metabolism Clinics*. 2006 Dec 1;35(4):725-751. <https://doi.org/10.1016/j.ecl.2006.09.006>, <https://pubmed.ncbi.nlm.nih.gov/17127143/>
3. Gouni-Berthold I, Krone W. Diabetic ketoacidosis and hyperosmolar hyperglycemic state. *Medizinische Klinik (Munich, Germany)*. 2006 Mar 1;101:100. <https://pubmed.ncbi.nlm.nih.gov/16802531/>
4. Fayfman M, Pasquel FJ, Umpierrez GE. Management of hyperglycemic crises: diabetic ketoacidosis and hyperglycemic hyperosmolar state. *Medical Clinics*. 2017 May 1;101(3):587-606. <https://doi.org/10.1016/j.mcna.2016.12.011> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6535398/>
5. Maletkovic J, Drexler A. Diabetic ketoacidosis and hyperglycemic hyperosmolar state. *Endocrinology and Metabolism Clinics*. 2013 Dec 1;42(4):677-695. <https://pubmed.ncbi.nlm.nih.gov/24286946/>
6. Bedaso A, Oltaye Z, Geja E, Ayalew M. Diabetic ketoacidosis among adult patients with diabetes mellitus admitted to emergency unit of Hawassa university comprehensive specialized hospital. *BMC research notes*. 2019 Dec;12:1-5. <https://doi.org/10.1186/s13104-019-4186-3>. <https://pubmed.ncbi.nlm.nih.gov/30871605/>
7. Shahid W, Khan F, Makda A, Kumar V, Memon S, Rizwan A. Diabetic ketoacidosis: clinical characteristics and precipitating factors. *Cureus*. 2020 Oct 4;12(10). <https://doi.org/10.7759/cureus.10792>
8. Jasper US, Opara MC, Pyiki EB. Prevalence and clinical pattern of acute and chronic complications in African diabetic patients. *British Journal of Medicine and Medical Research*. 2014 Oct 21;4(30):4908.
9. Pasquel FJ, Tsegka K, Wang H, Cardona S, Galindo RJ, Fayfman M, Davis G, Vellanki P, Migdal A, Gujral U, Narayan KV. Clinical outcomes in patients with isolated or combined diabetic ketoacidosis and hyperosmolar hyperglycemic state: a retrospective, hospital-based cohort study. *Diabetes care*. 2020 Feb 1;43(2):349-357. <https://doi.org/10.2337/dc19-1168>

### Creative Commons (CC) License

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY 4.0) license. This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.