

## Correlation of Fractional Excretion of Potassium with Increasing HbA1c

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### Abstract

**Background-**Our daily recommended use of potassium is 3.5 gm/day<sup>1</sup>. Potassium is a positive electrically charged particle called anions that takes part in carrying the nerve impulses. In healthy person safe level of potassium varies between 3.7 and 5.2 milliequivalent per liter (mEq/L)<sup>8</sup> Till the kidney functions are not compromised physiological level is maintained Even in low or high intake of potassium. Complication of hyperkalemia is slow heart beat and weak pulse but in case of severe hyperkalemia there may be stoppage of cardiac impulse.<sup>10</sup>

In poorly controlled diabetes mellitus II more breakdown of adipose tissue due to lack of insulin cause more ketone production and ketoacidois. This ketoacidosis along with hyperglycemia tends to pull the potassium out the cell. The combination of shift out of potassium from the cell and diminished potassium excretion by the kidney leads to hyperkalemia in case of Diabetes Mellitus type II.

**Material and method** 111 subjects having age between 30 to 55 both diabetic and non diabetic were selected. 5 ml blood was collected by vein puncture and fasting blood sugar, serum potassium level and HbA1c was estimated in the department of physiology .Fractional excretion of potassium will be calculated by the formula given below. Fractional excretion of potassium was calculated by the formula given below:

**FEK** = ( Urine K/Serum K)/ (Urine Cr /Serum Cr) X 100<sup>11</sup>

**Result** -Serum Creatinine was within normal limit <1mg/dl in Group A and B Where HbA1C range was 5-6.5. Even in Group C HbA1c range 6.6-7.9 serum creatinine was normal. Level of serum creatinine rises to 1.3 in group D where the HbA1C was >8% Mean excretion of potassium in urine was 36 mg/dl and 38mg/dl in HbA1C range between 5-5.6 % and 5.7-6.5 %respectively. in cases where HbA1C was > 8% excretion of potassium in urine was only 39mg/dl though it was increased a little 42mg/dl when HbA1C range was 6.5-7.9%

FEK was 8.1 till the HbA1C remains below 6.5% . FEK Gradually decreased to 7.5% in HbA1C range 6.6-6.9% and even more lower 6.8% when HbA1C was > 8%.

**Discussion** -In Persistent poor control of blood sugar level kidney fails to handle the potassium excretion and subsequently Serum potassium level begins to rise. kidney tries to maintain the serum potassium level not only by increasing the excretory rate of potassium .when there was poor glycemic control ,i.e HbA1c was more the 8 % in spite of having more excretion of potassium.

**Conclusion**-High level of potassium observed in case patients of diabetes mellitus. Regular check up of micro albumin in the urine ,Keeping the HbA1c level below 7 ,by cutting down the intake of potassium in diet, progress of kidney disease in case of Diabetes mellitus can be minimized.

**Key words** - HbA1c ,glycated hemoglobin.FEK Fractional excretion of potassium, FBS, Fasting Blood sugar

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### I. Introduction

On average people of ages above 14 the recommended use of Potassium is 3500milligram or 3.5 gm per day.<sup>1</sup> One of the best sources of potassium that we consume are baked potato, onion yoghurt, kidney beans, sun dried tomatoes fruits like banana, peaches fishes like salmon ,cod and many more.

Potassium is an positive electrically charged particle called anions that takes part in carrying the nerve impulses. In healthy person safe level of potassium varies between 3.5 and 5.0 milliequivalent per liter (mEq/L).<sup>8</sup> Even in low or high intake of potassium this physiological level is maintained as long as the kidney functions are not compromised. Total body potassium levels are regulated mostly by the kidneys, with only 5% to 10% of ingested potassium excreted in the feces.<sup>3</sup> FEK is a reliable and convenient marker of potassium excretion and in normal healthy person its average value is 8%( Range -4-16).<sup>11</sup>

Low level of potassium is usually observed after excessive sweating ,vomiting diarrhea, malnutrition burn, or may occur due to low intake of potassium, while high level is observed in cases of kidney

damage a common complication of diabetes mellitus where handling of potassium by kidney is compromised.

Potassium level above 5.5 mEq/l is hyperkalemia while more than 6.0 mEq/l reflect severe hyperkalemia. 8

More serious complication of hyperkalemia is slow heart beat and weak pulse but in case of severe hyperkalemia there may be stoppage of cardiac impulse. In Case of poorly controlled diabetes mellitus II more breakdown of adipose tissue due to lack of insulin cause more ketone production and ketoacidois. This ketoacidosis along with hyperglycemia pull the potassium out the cell. 4 In case of low capacity of kidney potassium excretion is decreased. 5

The combination of shift out of potassium from the cell and diminished potassium excretion by the kidney leads to hyperkalemia in case of Diabetes Mellitus type II

## II. Material and methods

The aim of the study was to know whether different glycemic level in the blood have any correlation with the potassium level . In present study 111 subjects having age between 30 to 55 both diabetic and non diabetic were selected from the OPD of RIMS Ranchi and from the different camps organized at different places for estimation of HbA1c during 5<sup>th</sup> February 2019 to September 2019 after getting clearance from the departmental ethical research committee.

**Study Design:** Cross sectional study

**Study Location:** Rajendra institute of medical sciences Ranchi

**Study Duration:** January 2019 to October 2019

**Sample size** -111

**Inclusion criteria:** Subjects having age between 30 to 55 both diabetic and non diabetic

**Exclusion criteria:**

The subjects on any diuretics, very sick patients known case of kidney and cardiovascular disease were excluded from the study.

**Procedure methodology-**

5 ml blood was collected by vein puncture and fasting blood sugar, serum potassium level and HbA1c was estimated in the Department of physiology .5 ml spot urine was also collected in sterile vial for estimation of urine creatinine and urine potassium.

The Jaffe method was used for the estimation of creatinine .Measurement of HbA1c was done by Ion Exchange Resin method.

Fractional excretion of potassium was calculated by the formula-

$$FEK = ( \text{Urine K/Serum K} ) / ( \text{Urine Cr /Serum Cr} ) \times 100 \quad 11$$

**Stastical analysis** ;- All the data collected were entered in Microsoft excel. Proportion mean and standard deviation were used to interpret the data .

## III. Result

A1c is a minor component of hemoglobin to which glucose is bound and referred to as glycate/ glycosylated hemoglobin. On the basis of Hb patients are classified as Normal- HbA1c <5.7, Pre diabetic HbA1c -5.7-6.4, Diabetic- HbA1c >6.5 7

In the study All subjects were divided in 4 groups

Gr A- HbA1c % ( 5-5.6), Group B- HbA1c % (5.7-6.5) Group C -HbA1c % ( 6.6-7.9),Group D- Hba1c% (>8)

**Table 1-** Relation of HbA1c and range of FBS And Mean FBS

Group (n-111)	HbA1c %	Range of FBS (mg/dl)	Mean FBS (mg/dl)
A (17)	5-5.6	80-112	97.94 ±9.5
B (28)	5.7-6.5	90-142	114±22.15
C (35)	6.6-7.9	96-197	144±31.4
D (31)	>8	138-253	198±38.52

Table 1 shows the average blood sugar level in different HbA1c level. The average blood sugar level in patient of group Group A (HbA1c % -5-5.6 ) was 97.94mg/dl in Group B (5.7-6.5) was 114 mg/dl Group C HbA1c % ( 6.6-7.9) was144mg/dl while in Group D (HbA1c% >8) was 198mg/dl The range of blood sugar in patents of HbA1c >8% varies between 138-253 mg/100ml.

**Table 2** -Comparative chart of Mean HbA1c, Serum K, Serum Cr, Urine K Urine Cr and FEK

HbA1C	Mean Serum K (mEq/L).	Mean Serum Cr (mg/dl)	Mean Urine K (mEq/L).	Mean Urine Cr (mg/dl)	FEK%
5-5.6	3.8	.92	36	106	8.1
5.7-6.5	3.9	1	38	120	8.1
6.6-7.9	4.8	1	42	116	7.5
>8	5.22	1.3	39	142	6.8

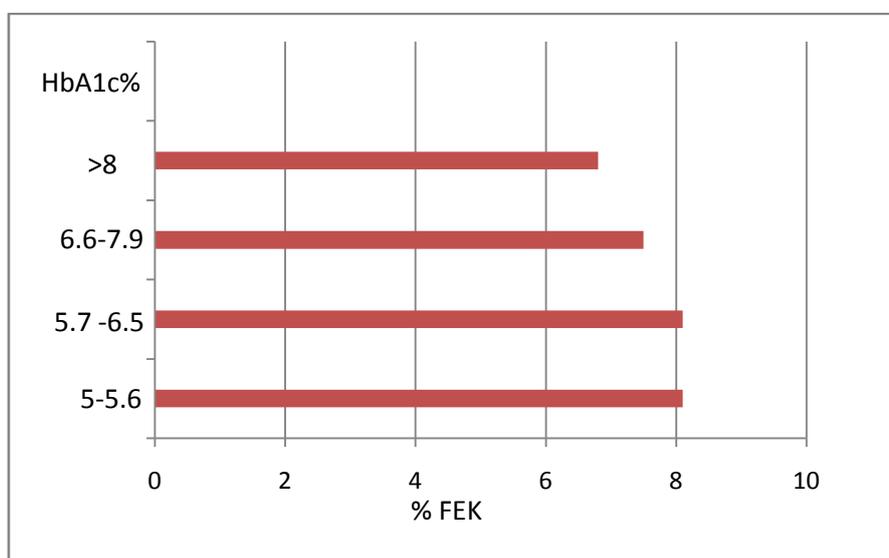
Table 2 shows Serum Creatinine was within normal limit <1mg/dl in Group A and B Where HbA1C range was 5-6.5. Even in Group C HbA1c range 6.6-7.9 serum creatinine was normal. Level of serum creatinine rises to 1.3 in group D where the HbA1C was >8%

Mean excretion of potassium in urine was 36 mg/dl and 38mg/dl in HbA1C range between 5-5.6 % and 5.7-6.5 % respectively. in cases where HbA1C was > 8% excretion of potassium in urine was only 39mg/dl though it was increased a little 42mg/dl when HbA1C range was 6.5-7.9%

**Table -3** Relation of Mean HbA1C and Mean Serum Potassium

Group	HbA1c	Range Serum K	Mean Serum Potassium	Std deviation
A	5-5.6	3.4-4.7	3.8	±.44
B	5.7-6.5	3.9-5.6	3.9	±.47
C	6.6-7.9	3.8-5.8	4.8	±.54
D	>8	3.6-5.9	5.22	±.51

Table 3 shows increasing trend of serum potassium level . It was 3.8meq/L in group A where HbA1C was ranged between 5- 5.6% increased to 4.8 in group C (HbA1c -6.6-7.9%) while it was 5.22 in group D Where HbA1C >8%



**Graph -1** shows decreasing trend in FEK with increasing trend of HbA1C

FEK was 8.1 till the HbA1C remains below 6.5% . FEK Gradually decreased to 7.5% in HbA1C range 6.6-6.9% and even more lower 6.8% when HbA1C was > 8%

#### IV. Discussion

In the study that serum creatinine remains normal till there is good control of blood sugar level but increased in case of poor glycemic control. It was 1.3 In cases when HbA1C was >8% .

It was observed that serum potassium remains normal till HbA1C level was within 6.5% Nondiabetic conditions .<sup>12</sup>

Once the HbA1C of the patient begins to rise level of potassium also begins to rise and in case of poor glycemic control HbA1C > 8% it was 5.22meq/L .

In Case when blood sugar level is raised the kidney tries to maintain the serum potassium level by increasing the excretion of potassium in the urine . But in poor Glycemic control though the excretion of potassium is increased however FEK was decreased and the Potassium level rises.<sup>6</sup> Perez GO, Lespier

L, Knowles R, Oster JR, Vaamonde CA 1977 also observed high serum potassium and lower fractional potassium excretion in the diabetic. <sup>6</sup>

The study shows the persistent hyperglycemic condition progressively impairs the fractional excretion of potassium and may be a leading cause of increased potassium level in case of chronic diabetes patient with poor glycaemic control.

### V. Conclusion

in case of high level of potassium observed in case patients of diabetes mellitus ,patient must be advised to cut down the intake of potassium in their diet like banana, potato, legumes tomato that are particularly rich in potassium content. Regular check up of potassium level may guide us the the status of functioning of the kidney in case of Diabetes mellitus typeII. Regular check up of micro albumin in the urine ,Keeping the HB1Ac level below 7,by cutting down the intake of potassium in diet, progress of kidney disease in case of Diabetes mellitus can be minimized.

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