



## ASSOCIATION OF PARATHYROID HORMONE WITH HbA1c IN DIABETES MELLITUS PATIENTS

## General Medicine

|                           |                                                                                                                       |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------|
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## ABSTRACT

**Background:** Diabetes mellitus (DM) is associated with hyperglycemia and disturbances in calcium metabolism. Parathyroid hormone (PTH) may influence glucose control by affecting insulin sensitivity and beta-cell function. **Objective:** To assess the association between serum PTH levels and glycemic control (HbA1c) in DM patients. **Method:** A cross-sectional study of 100 adult DM patients was conducted at LLRM Medical College, Meerut. Serum PTH, HbA1c, fasting glucose, and insulin levels were measured. Statistical analysis included Chi-square tests and Pearson correlation. **Result:** 88% of patients had elevated PTH. A significant association was found between high PTH and HbA1c >6.5% ( $p = 0.001$ ). A moderate positive correlation was noted between PTH and HbA1c ( $r = 0.42$ ,  $p < 0.001$ ). PTH levels also increased with diabetes duration. **Conclusion:** High PTH levels are significantly associated with poor glycemic control in DM patients. PTH assessment may aid in comprehensive diabetes management.

## KEYWORDS

Parathyroid Hormone, Diabetes Mellitus, HbA1c

## BACKGROUND

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia, often accompanied by disturbances in calcium and phosphate metabolism. Parathyroid hormone (PTH), a key regulator of calcium homeostasis, controls bone resorption, renal calcium reabsorption, and vitamin D activation to maintain calcium balance.

Recent research suggests that PTH may influence glucose metabolism, contributing to insulin resistance and impaired beta-cell function. Elevated PTH levels — commonly observed in both primary and secondary hyperparathyroidism — are associated with a higher prevalence of glucose intolerance and DM. Potential mechanisms include PTH's interference with insulin receptor signaling, altered glucose uptake, and chronic low-grade inflammation. Additionally, vitamin D deficiency, frequently seen in DM, may further dysregulate PTH secretion and worsen insulin resistance.

HbA1c, a widely accepted marker of long-term glycemic control, reflects average blood glucose levels over the previous 2-3 months. The relationship between elevated PTH levels and poor glycemic control remains under-explored, though emerging studies suggest a possible link that may influence diabetes outcomes.

This study aims to investigate the association between PTH levels and HbA1c in patients with DM, exploring whether elevated PTH correlates with poorer glycemic control and identifying potential metabolic disturbances contributing to this relationship.

## AIMS AND OBJECTIVE:

To investigate the association between serum PTH levels and HbA1c in patients with diabetes mellitus, and to explore whether elevated PTH correlates with poorer glycemic control.

## MATERIAL AND METHOD

The study was conducted on patients of DM, who have attended the medicine OPD, endocrinology OPD Or admitted in medicine ward at LLRM medical college and associated SVBP Hospital, Meerut during the period from December 2022 to July 2024.

**Study Type:** Cross sectional study.

## Inclusion Criteria:

- Adults >18 years
- Confirmed diagnosed DM by ADA guidelines.
- Exclusion Criteria:**
  - Pregnant female
  - Patients on Renal replacement therapy.
  - Patients who had undergone Parathyroidectomy.
  - Any drug causing PTH abnormality like lithium, loop diuretics etc.
  - Patients with Thyroid Dysfunction.

## RESULTS

Patient Characteristics

- Total Patients: 100
- Mean Age:  $47.18 \pm 13.20$  years
- Sex Distribution: 57% male, 43% female

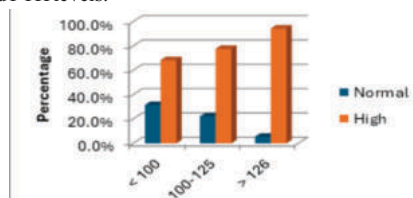
Table 1 Fasting Blood Sugar And PTH

| Fasting blood glucose | PTH    |       |      |       | Total | Chi-square | P value |
|-----------------------|--------|-------|------|-------|-------|------------|---------|
|                       | Normal |       | High |       |       |            |         |
|                       | No.    | %     | No.  | %     |       |            |         |
| <100                  | 6      | 31.6% | 13   | 68.4% | 19    | 10.619     | 0.005   |
| 100-125               | 2      | 32.2% | 7    | 77.8% | 9     |            |         |
| >125                  | 4      | 5.6%  | 68   | 94.4% | 72    |            |         |
| Total                 | 12     | 12%   | 88   | 88%   | 100   |            |         |

68.4% of individuals with fasting glucose <100 mg/dL have high PTH levels, increasing to 77.8% for those with levels between 100-125 mg/dL, and further to 94.4% for those with levels >126 mg/dL.

## Statistical Significance:

The Chi-square test result (value = 10.619, p-value = 0.005) indicates a statistically significant association between fasting blood glucose levels and PTH levels.



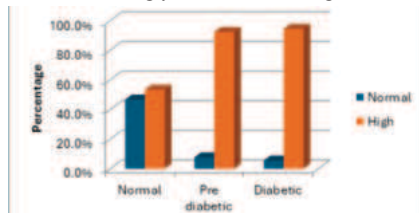
**Table 2 HbA1c Levels and PTH:**

| HbA1C       | Pth    |       |      |       | Total | Chi-square | P value |
|-------------|--------|-------|------|-------|-------|------------|---------|
|             | Normal |       | High |       |       |            |         |
|             | No.    | %     | No.  | %     |       |            |         |
| Normal      | 7      | 46.7% | 8    | 53.3% | 15    | 20.131     | 0.001   |
| Prediabetic | 1      | 7.7%  | 12   | 92.3% | 13    |            |         |
| Diabetic    | 4      | 5.6%  | 68   | 94.4% | 72    |            |         |
| Total       | 12     | 12%   | 88   | 88%   | 100   |            |         |

53.3% of individuals with normal HbA1c have high PTH levels, this percentage increases to 92.3% for pre-diabetics and 94.4% for diabetics.

**Statistical Significance:**

The Chi-square test result (value = 20.131, p-value = 0.001) indicates a statistically significant association between HbA1c levels and PTH levels. This suggests that higher HbA1c levels, indicative of worse glycemic control, are strongly associated with higher PTH levels.

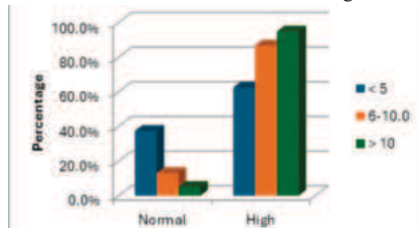
**Table 3 PTH and Duration Of DM**

| Duration of diabetes in years | Pth    |      |      |       | Total | Chi square | P value |
|-------------------------------|--------|------|------|-------|-------|------------|---------|
|                               | Normal |      | High |       |       |            |         |
|                               | No.    | %    | No.  | %     |       |            |         |
| <5                            | 3      | 37.5 | 5    | 62.5% | 8     |            |         |
| 5-10                          | 7      | 13.2 | 46   | 86.8% | 53    | 6.734      | 0.034   |
| >10                           | 2      | 5.1  | 37   | 94.9% | 39    |            |         |
| Total                         | 12     | 12%  | 88   | 88%   | 100   |            |         |

Among patients with diabetes for less than 5 years, 62.5% have high PTH levels. This increases to 86.8% for those with 6-10 years of diabetes, and further to 94.9% for those with over 10 years of diabetes.

**Statistical Significance:**

Chi-square value = 6.743, p-value = 0.034, indicating a significant association between the duration of diabetes and high PTH levels

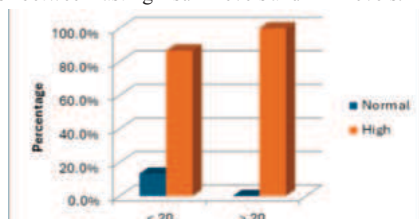
**Table 4 Fasting Insulin Levels And PTH Levels**

| Fasting insulin levels | Pth    |       |      |       | Total | Chi square | P value |
|------------------------|--------|-------|------|-------|-------|------------|---------|
|                        | Normal |       | High |       |       |            |         |
|                        | No.    | %     | No.  | %     |       |            |         |
| <20                    | 12     | 13.3% | 78   | 86.7% | 90    | 1.515      | 0.604   |
| >20                    | 0      | 0%    | 10   | 100%  | 10    |            |         |
| Total                  | 12     | 12%   | 88   | 88%   | 100   |            |         |

Patients with fasting insulin levels below 20, 86.7% had high PTH levels, while all patients (100%) with fasting insulin levels above 20 had high PTH levels.

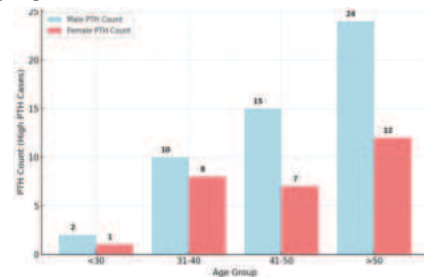
**Statistical Significance:**

Chi-square value = 1.515, p-value = 0.604, indicating no significant association between fasting insulin levels and PTH levels.

**Table 5 HbA1c Levels And Age Group**

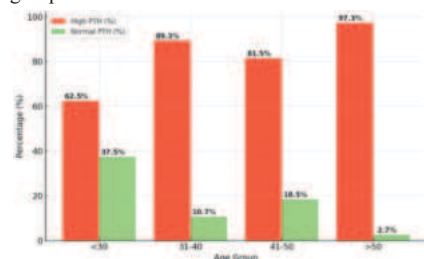
| Age group  | Normal HbA1c | Pre-diabetic | Diabetic   | Total | Chi-square | P value |
|------------|--------------|--------------|------------|-------|------------|---------|
| < 5 years  | 2 (25.0%)    | 0 (0.0%)     | 6 (75.0%)  | 8     | 2.617      | 0.624   |
| 6-10 years | 8 (15.1%)    | 6 (11.3%)    | 39 (73.6%) | 53    |            |         |
| 10 years   | 5 (12.8%)    | 7 (17.9%)    | 27 (69.2%) | 39    |            |         |
| Total      | 15 (15.0%)   | 13 (13.0%)   | 72 (72.0%) | 100   |            |         |

- 75% of patients with < 5 years of diabetes were in the diabetic range
- The proportion remained high for 6-10 years (73.6%) and >10 years (69.2%), showing persistent poor glycemic control across all age groups

**Table 6 PTH Levels And Age Group**

| Age Group | Normal PTH (n, %) | High PTH (n, %) | Total (n) |
|-----------|-------------------|-----------------|-----------|
| < 30      | 3 (37.5%)         | 5 (62.5%)       | 8         |
| 31-40     | 3 (10.7%)         | 25 (89.3%)      | 28        |
| 41-50     | 5 (18.5%)         | 22 (81.5%)      | 27        |
| 50        | 1 (2.7%)          | 36 (97.3%)      | 37        |
| Total     | 12 (12.0%)        | 88 (88.0%)      | 100       |

- <30 years: 37.5% had normal PTH, but 62.5% had elevated PTH.
- 31-40 years: 10.7% had normal PTH, while 89.3% had elevated PTH.
- 41-50 years: 18.5% had normal PTH, with 81.5% having elevated PTH — a slight dip compared to younger groups.
- Higher PTH levels increased with age, peaking at 97.3% in the >50 years group.

**DISCUSSION**

This study demonstrates a significant association between elevated parathyroid hormone (PTH) levels and poor glycemic control in diabetic patients, with 88% showing elevated PTH and a moderate positive correlation with HbA1c ( $r = 0.42$ ,  $p < 0.001$ ). These findings suggest that PTH may contribute to glucose dysregulation, possibly through impaired insulin sensitivity and inflammation.

Elevated PTH was more frequent with longer diabetes duration and older age, likely due to chronic metabolic stress and secondary hyperparathyroidism. Although no significant link was found with fasting insulin, insulin resistance is multifactorial and may not correlate directly with PTH alone.

These results support the potential role of PTH as a marker of glycemic control. However, due to the cross-sectional design, causality cannot be established. Further prospective studies are needed to evaluate whether managing PTH levels can improve diabetes outcomes.

**CONCLUSION**

This study demonstrates a significant association between elevated PTH levels and poor glycemic control in diabetic patients. Monitoring

PTH levels may provide additional insights into the management of diabetes and its complications. Future longitudinal studies should explore causal relationships and potential interventions.

### Limitations

1. **Small Sample Size:** The study was conducted on a limited sample of 100 patients.
2. **Cross-Sectional Design:** The study design does not establish causality between PTH levels and HbA1c.
3. **Lack of Control for Confounding Factors:** Variables such as dietary calcium intake, vitamin D supplementation, and renal function were not accounted for.

### REFERENCES

1. Frost M, Abrahamsen B, Nielsen TL, Hagen C, Andersen M, Brixen K. Vitamin D status and PTH in young men: a cross-sectional study on associations with bone mineral density, body composition, and glucose metabolism. *Clin Endocrinol* 2010; 73: 573-80.
2. Chang E, Donkin SS, Teegarden D. Parathyroid hormone suppresses insulin signaling in adipocytes. *Mol Cell Endocrinol* 2009; 307: 77-82.
3. Komaba H, Kakuta T, Fukagawa M. Diseases of the parathyroid gland in chronic kidney disease. *Clin Exp Nephrol* 2011; 15: 797-809.
4. Stanley T, Bredella MA, Pierce L, Misra M. The ratio of parathyroid hormone to vitamin D is a determinant of cardiovascular risk and insulin sensitivity in adolescent girls. *Metab Syndr Relat Disord* 2013; 11: 56-62.
5. Ivarsson KM, Clyne N, Almquist M, Akaberi S. Hyperparathyroidism and new-onset diabetes after renal transplantation. *Transplant Proc* 2014; 46: 145-50.
6. Hamed EA, Abu Faddan NH, Adb Elhafeez HA, Sayed D. Parathormone – 25(OH)-vitamin D axis and bone status in children and adolescents with type 1 diabetes mellitus. *Pediatr Diabetes* 2011; 12: 536-46.
7. Chiu KC, Chuang LM, Lee NP, Ryu JM, McGullam JL, Tsai GP, et al. Insulin sensitivity is inversely correlated with plasma intact parathyroid hormone level. *Metabolism* 2000; 49: 1501-5.
8. Alemzadeh R, Kichler J. Parathyroid hormone is associated with biomarkers of insulin resistance and inflammation, independent of vitamin D status, in obese adolescents. *Metab Syndr Relat Disord* 2012; 10: 422-9.
9. Hjelmæsæth J, Hofv D, Aasheim ET, et al. Parathyroid hormone, but not vitamin D, is associated with the metabolic syndrome in morbidly obese women and men: a crosssectional study. *Cardiovasc Diabetol* 2009; 8:7.