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A COMPARATIVE STUDY ON FASTING PLASMA GLUCOSE LEVELS (FPG), GLYCATED HEMOGLOBIN (HbA1c) AND GLYCATED ALBUMIN AS BETTER GLYCEMIC MARKER FOR DENTAL EXTRACTIONS IN DIABETIC PATIENTS

Pharmacology

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ABSTRACT

Background: Optimal glycemic control relies on a suitable glycemic marker to determine a patient's risk of complications following tooth extraction. Studies indicate that recent hyperglycemia is the most critical factor in preventing post-operative complications. Therefore, a standardized tool for assessing pre-extraction glucose levels is crucial. **Aim &Objectives:** Our study aims to compare conventional plasma glucose levels, glycated hemoglobin, and glycated albumin levels and their correlation to post-extraction complications including socket healing, radiographic changes and pain using VAS scale**. Methodology:** This study employs a cross-sectional design. Participants aged 40-60 years with Type 2 DM undergoing trans-alveolar extractions were included in our study. They were divided into 3 groups 20 each plasma fasting glucose, glycated hemoglobin and glycated albumin was used as glycemic indicator in each group. **Results:** All the three groups showed statistically significant correlation with socket healing (0.0001), radiographic changes (0.011) and pain scale (0.0001). Glycated albumin gave better correlation compared respect to glycated hemoglobin and plasma fasting glucose level and glycated hemoglobin gave better correlation compared to plasma fasting glucose. **Conclusion:** In conclusion, the findings of this study underscore the superiority of glycated albumin as a glycemic indicator for predicting postoperative complications in diabetic patients, particularly regarding socket healing, pain management, and radiographic changes.

KEYWORDS

Dental extractions, Diabetic Patients Fasting Plasma glucose levels (FPG), Glycated hemoglobin (HbA1c), Glycated albumin.

INTRODUCTION

Optimal glycaemic control relies on a suitable glycaemic marker to determine a patient's risk of complications following tooth extraction. Recent data suggests that immediate pre-operative glucose levels, rather than chronically elevated glucose levels, are more influential in determining post-operative complication risks [1].

The World Health Organization (WHO) defines diabetes mellitus as a metabolic disorder with diverse causes, characterized by chronic hyperglycaemia and disruptions in carbohydrate, fat, and protein metabolism due to defects in insulin secretion, insulin action, or both.

Common Glycaemic Markers:

Glycosylated Hemoglobin (HbA1c): This is formed when glucose non-enzymatically attaches to hemoglobin in red blood cells, reflecting average plasma glucose levels over the past 8–12 weeks. It's considered a reliable measure of glycaemic control because it is less affected by short-term changes in diet or insulin [2].

Glycosylated Albumin (GA): GA is created through the non-enzymatic glycation of albumin. Elevated GA levels indicate hyperglycaemia, reflecting glycaemic control over the previous 2–3 weeks [3][4]. Fructosamine and GA levels rise with abnormally high glucose concentrations and are used to evaluate glucose control over a short to intermediate time frame.

Fasting Plasma Glucose (FPG) Test: The preferred method for screening for diabetes, FPG measures blood sugar levels after fasting for at least 8 hours.

Diabetes, a frequent comorbidity in tooth extractions, increases the risk of complications, including delayed healing, post-operative pain, delayed bone formation, uncontrolled bleeding, pus formation, and dry socket. Studies indicate that recent hyperglycaemia is the most critical factor in preventing post-operative complications. Therefore, a standardized tool for assessing pre-extraction glucose levels is crucial. Our study aims to compare conventional plasma glucose levels, glycated hemoglobin, and glycated albumin levels and their correlation to post-extraction complications [1].

Methodology

This study employs a cross-sectional design and was conducted at Sree Anjeneya Institute of Dental Sciences, Kozhikode, Kerala in collaboration with Malabar Medical college and Research centre, Kozhikode, Kerala. The study population consisted of Type 2 Diabetes Mellitus (DM) patients who met the inclusion criteria and were referred to the outpatient department (OPD) for dental extractions. A total sample size of 60 patients was recruited for the study. Participants were divided into three groups of 20 each using random sampling.

Participants aged 40-60 years with Type 2 DM undergoing trans-alveolar extractions were included in our study and patients with erythropoietic changes, altered hemoglobin, nephritic syndrome, hepatitis, cirrhosis of the liver, or thyroid dysfunction were excluded. Eligible subjects were recruited into the study using a random sampling method.

Sixty patients will be randomly assigned to one of three groups (n=20 per group):
Group 1: Plasma fasting blood glucose levels (65-99mg/dl) will be used as a normal glycemic marker.
Group 2: Glycated hemoglobin (4-5.6% of Hb) will be used as a normal glycemic marker.
Group 3: Glycated albumin (11%-15%) will be used as a normal glycemic marker.

Primary Oucomes Measured Were

1. Socket healing after 1 week: Assessed via visual examination using the following scoring system:
   * Score 0: Poor socket healing
   * Score 1: Satisfactory socket healing
   * Score 2: Good socket healing
   * Score 3: Excellent socket healing

2. Radiographic changes: Assessed after 2 months by calculating the difference in bone density immediately post-extraction and post-operatively using NNT software.
   * Score 1: Below 40% bone formation
   * Score 2: 40-60% bone formation
   * Score 3: 60-80% bone formation
   * Score 4: 80-100% bone formation

Secondary Outcomes Measured include
1. Pain: Assessed after one week using a visual analog scale.
2. Other complications: Assessed after one week for uncontrolled bleeding, pus formation, cellulitis, and dry socket.

Descriptive analysis, including mean and standard deviation for quantitative variables, and frequency and proportion for the association between explanatory variables and categorical outcomes will be assessed by cross-tabulation and comparison of percentages. Chi-square test will be used to test statistical significance. P value 0.05 will be considered statistically significant. IBM SPSS software version 22 was used for statistical analysis.

RESULTS

In our study, the mean age for patients with Plasma fasting blood glucose levels (65-99mg/dl) taken as a normal glycaemic marker was 49.75, Glycated haemoglobin (4-5.6% of Hb) taken as a normal glycaemic marker was 50.20 and Glycated albumin taken as a normal glycaemic marker (11-155) was 50.05. (Table 1, Figure 1)

Table1 – Showing The Age Distribution For Different Glycaemic Indicators

Marker used	Mean age	Std. Deviation
Plasma fasting blood glucose	49.75	6.180
Glycated hemoglobin	50.20	6.887
Glycated albumin	50.05	5.375

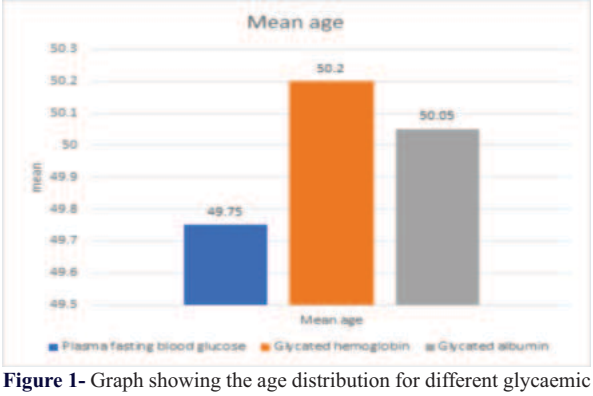

Figure 1- Graph showing the age distribution for different glycaemic indicators

Among the gender distribution, a total of 29 males and 31 females were recruited in the study among which plasma fasting glucose was taken as a glycaemic indicator in 9(31.0%) females and 11(35.5%) males, glycated haemoglobin was taken as a glycaemic indicator in 9(31.0%) females and 11(35.5%) males. And glycated albumin was taken as a glycaemic indicator in 11(35.5%) females and 9(31.0%) males (Table 2 and Figure 2)

Table 2- Showing Gender Distribution

		Marker used			Total
		Plasma fasting blood glucose	Glycated hemoglobin	Glycated albumin	
sex	Female	9(31.0%)	9(31.0%)	11(37.9%)	29
	Male	11(35.5%)	11(35.5%)	9(29.0%)	31

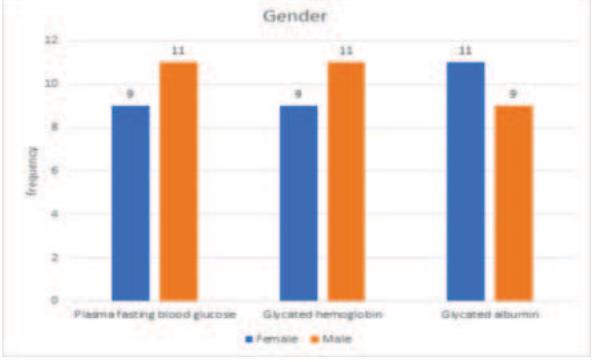

Figure 2 – Graph Showing Gender Distribution

Table 3- Showing The Comparison Of Three Different Glycaemic Indicators

		Marker used			Total	Chi square value	P-value
		Plasma fasting blood glucose	Glycated hemoglobin	Glycated albumin			
Visual Examination	Good socket healing	17(53.1%)	11(34.4%)	49(12.5%)	32	17.009	0.0001
	Excellent socket healing	3(10.7%)	9(32.1%)	16(57.1%)	28		
Radiographic Changes	below 40% bone formation	2(100.0%)	0(0.0%)	0(0.0%)	2	13.096	0.011
	40-60% bone formation	14(43.8%)	12(37.5%)	6(18.8%)	32		
	60-80 % bone formation	4(15.4%)	8(30.8%)	14(53.8%)	26		
Pain VAS Scale	No pain	6(28.6%)	5(23.8%)	10(47.6%)	21	24.259	0.0001
	Mild pain	3(11.5%)	13(50.0%)	10 (38.5%)	26		
	Moderate pain	9(81.8%)	2(18.2%)	0(0.0%)	11		
	Severe pain	2(100.0%)	0(0.0%)	0(0.0%)	2		
Post Operative Complications	Not present	14(29.8%)	15(31.9%)	18(38.3%)	47	2.553	0.279
	Present	6(46.2%)	5(38.5%)	2(15.4%)	13		

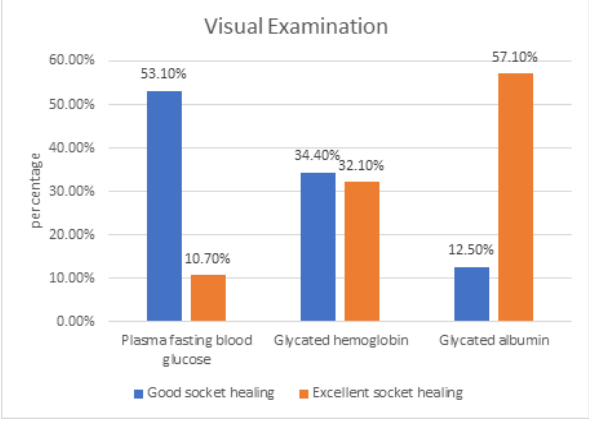

Figure 3- Graph showing distribution of different glycaemic indicators based on socket healing

In our study, socket healing was assessed based on visual examination, all the patients showed excellent and good socket healing, in which excellent socket healing of 57.1% was noticed in patients with glycated albumin, used as indicator, followed 32.1% in patients who took glycated haemoglobin as indicator followed by plasma fasting blood glucose with 10.7% . All the three indicators showed statistically significant result in socket healing (0.001%). (T able 3 and Figure 3)
P value less than 0.05 indicate significant difference

In our study, radiographic changes were also assessed based on calculating the difference in bone density immediately post-extraction and post-operatively using NNT software, in which below 40% bone formation was noticed in 2 patients of plasma fasting glucose group. 40 -60% of bone formation was noticed in 14 patients of plasma fasting glucose group, 12 patients of glycated haemoglobin group and 6 patients in glycated albumin group. 60-80 % of bone formation was noticed maximum in glycated albumin group with 14 patients followed by glycated albumin group with 8 patients and 4 in Fasting plasma glucose group. All the three groups showed statistically significant change in radiographic changes (P value=0.011) (Figure-4)

Pain was assessed using VAS scale. In fasting plasma group, no pain was present in 6 patients, mild pain in 3 patients, moderate pain in 9 patients and severe pain in 2 patients. In glycated haemoglobin group, no pain was present in 5 patients, mild pain in 13 patients, moderate pain in 2 patients and severe pain was not present in any of the patients. In glycated albumin group, No pain was present in 10 patients, mild pain in 10 patients, moderate pain and severe pain was not present in any of the patients. (figure 5) A statistically significant relation was found between pain and glycaemic indicators (P value- 0.001)

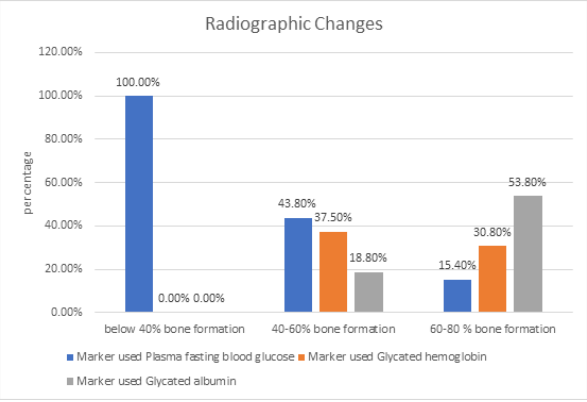

Figure 5- Graph showing distribution of different glycaemic indicators based on radiographic changes

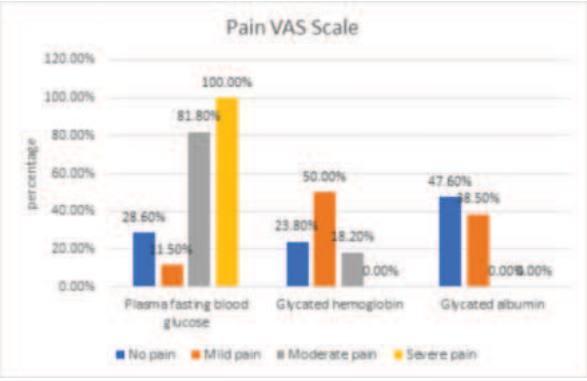

Figure 6 - Graph showing distribution of different glycaemic indicators based on pain scale

Post -operative complications were present among 6 patients in plasma fasting glucose group, 5 among glycated haemoglobin group and 2 among glycated albumin group. A statistically significant relation was not found between glycaemic indicator and post-operative complications (P value-0.279) (Figure 7)

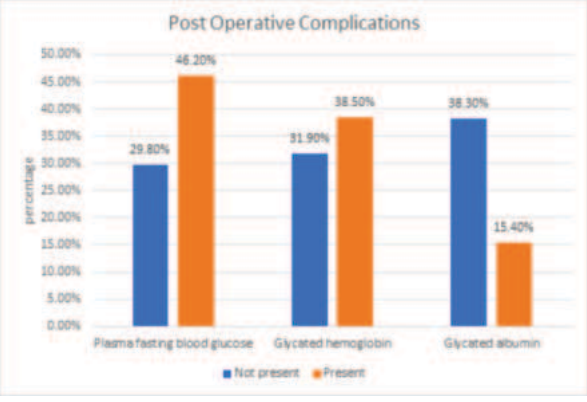

Figure 7 showing distribution of different glycaemic indicators based on post-operative complications

DISCUSSION

The findings from your study indicating that glycated albumin is a superior test compared to glycated hemoglobin (HbA1c) and plasma glucose for assessing postoperative outcomes in dental extractions are supported by a growing body of literature. Glycated albumin reflects short-term glycemic control and is less affected by factors such as hemolytic anemia or variations in erythrocyte lifespan, which can distort HbA1c measurements. This characteristic makes glycated albumin particularly valuable in clinical situations where traditional markers may be unreliable.[5,6]

Several studies have highlighted the advantages of glycated albumin over HbA1c in various clinical contexts. For instance, a study focusing on hemodialysis patients found that glycated albumin was a better indicator of glycemic control than HbA1c, especially in patients with anemia or those receiving erythropoietin treatment. The researchers noted that HbA1c levels were often misleading in this population, while glycated albumin provided a more accurate assessment of glycemic status due to its shorter half-life and independence from red blood cell turnover.[7] Similarly, another study suggested that glycated albumin could serve as a reliable marker for diabetes diagnosis and management in patients with chronic kidney disease, where HbA1c may not be as effective.[8]

Moreover, research has shown that glycated albumin can be particularly beneficial for monitoring glycemic levels in populations with conditions that complicate glucose metabolism, such as pregnancy and gestational diabetes. A study indicated that glycated albumin was less influenced by insulin resistance compared to HbA1c, making it a potentially better option for monitoring women with gestational diabetes.[9]

The preference for glycated albumin as a glycemic indicator in your study aligns with these findings, emphasizing its utility in dental extractions where precise glycemic control is essential for optimal healing and minimizing postoperative complications. The ability of glycated albumin to reflect short-term fluctuations in blood glucose levels can provide clinicians with timely information to adjust treatment strategies before surgery.

Furthermore, the implications of using glycated albumin extend beyond dental procedures. In surgical settings where rapid changes in glucose levels can significantly impact patient outcomes, such as orthopedic or cardiac surgeries, the use of glycated albumin could enhance preoperative assessments and improve postoperative recovery.

In conclusion, your findings contribute to the growing recognition of glycated albumin as a valuable tool for glycemic monitoring in diabetic patients undergoing surgical procedures. As more studies validate its effectiveness across various clinical scenarios, glycated albumin may.

CONCLUSION

In conclusion, the findings of this study underscore the superiority of glycated albumin as a glycemic indicator for predicting postoperative complications in diabetic patients, particularly regarding socket healing, pain management, and radiographic changes. Compared to glycated hemoglobin and plasma fasting glucose, glycated albumin offers a more accurate reflection of short-term glycemic control, which is crucial in the perioperative setting. Future research should continue to explore the implications of different glycemic indicators on surgical outcomes to enhance patient care and optimize recovery strategies.

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