Percentage of Change in Clinical Outcomes of Albumin-CGFsgel as an Adjunct to Scaling and Root Planing in Stage III Periodontitis (Randomized Controlled Clinical Trial).

Abstract

Background: Periodontitis is a chronic inflammatory disease characterized by progressive destruction of the periodontal supporting tissues Although scaling and root planing (SRP) remains the gold standard for non-surgical periodontal therapy, complete elimination of periodontal pathogens could not always be achieved Therefore, adjunctive therapeutic modalities capable of enhancing periodontal wound healing have gained increasing attention. Albumin-based concentrated growth factors (Alb-CGFs) represents a modified platelet concentrate with prolonged structural stability and sustained release of biologically active molecules, which could enhance periodontal healing outcomes.

Aim: Is to analyse the percentage of improvement in clinical parameters following adjunctive use of albumin based concentrated growth factorsin the non-surgical treatment of periodontitis patients.

Methods:The present investigation involved20Participantsclassified with stage III grade A periodontitis.SRP was conducted to all Patients. They were categorized into two equal groups at random. Where in group I the pockets were administered with Alb-CGFs gel; group II was considered asthe control group. Clinical indices were measured at baseline, 1 and 3 months post-therapy.

Results: throughout the study period, both groups demonstrated significant enhancement in periodontal parameters. Nevertheless, the Alb-CGFs exhibited greater percentage reduction in bleedingon probing (BoP), and pocket depth (PD), along with a higher percentage of clinical attachment gain in comparison to the control group. However,in plaque index (PI), Alb-CGFs demonstrated higher reduction numerically the difference did not reach statistical significance.

Conclusion: To conclude the adjunctive application of Alb-CGFs gel could provide superior clinical improvement in comparison to SRP alone in the periodontal therapy of periodontitis patients.

Keywords: Alb-CGFs, Periodontitis, Concentrated growth factors, SRP.

Introduction

The oral cavity consists of a high variety of microbial community composed of various bacterial species that contribute significantly to maintaining periodontal health and tissue homeostasis(1). In a healthy physiological environment, these microorganisms exist in a state of physiological harmony with the host. However, disruption of this harmonycould lead to the formation of a dysbiotic biofilm capable of triggering an immuno-inflammatory response, ultimately leading to progressive destruction of the periodontal supporting tissues and eventual tooth loss if not properly managed(2).

Periodontitis is considered one of the most prevalent chronic inflammatory diseases affecting the tooth-supporting structures and continues to represent a significant public health issue worldwide. The increasing prevalence of periodontitis, together with the aging population and the limitations of currently available preventive approaches, has been associated with a substantial escalation in periodontal disease burden worldwide(3). Consequently, the development of more effective therapeutic modalities remains an important goal in periodontal research.

Non-surgical periodontal therapy (NSPT), which includes scaling and root planing, is still the primary treatment for periodontitis. The primary goal of NSPT is to remove pathogenic subgingival biofilm and calculus deposits from contaminated root surfaces, hence reducing periodontal inflammation and stopping disease progression.This has prompted SRP to become the gold standard in treatment of periodontitis (4, 5). Although traditional SRP has shown favourable clinical effects, past investigations have revealed that full eradication of periodontal bacteria and calculus deposits could not always be possible with SRP alonethis is especially noted in instances of inadequate instrumentation of deep pockets and teeth with complex anatomical variations(6). Therefore, considerable attention has recently been directed toward local drug delivery systems (LDDs) therapeutic approaches aimed at enhancing the clinical efficacy of NSPT.

Modern advances made it possible for the locally applied medications to achieve a substantially positive clinical response while avoiding the undesirable side effects of systemic agents. This is increasingly becoming the standard of care with the development of various LDDs(7).LDDs achieve their therapeutic goals by delivering the active ingredients directly to the periodontal pockets where the desired effect is needed. The sustained or controlled release of the therapeutic agent is often very effective in controlling the microbial spread (8). This targeted delivery of therapeutic agents spares the patient from the invasive nature of systemic therapy, avoids the undesirable general and gastrointestinal side effects of systemic therapeutic agents, and facilitates patients compliance with prescribed treatment (9).

Various LDDs modalities have been previously studied as an adjunctive therapeutic modality in the treatment of periodontitis with the aim of enhancing the clinical outcomes of non-surgical periodontal therapy. These modalities include erythropoietin(10), zinc oxide(11), statins(12) and much more.Among the various LDDs modalities investigated in periodontal therapy, autologous platelet concentrates have gained substantial interest because of their regenerative potential and ability to accelerate wound healing. Concentrated growth factors (CGFs)

represent a newer generation of platelet concentrates characterized by high concentrations of growth factors and fibrin matrices capable of promoting angiogenesis, fibroblast proliferation, extracellular matrix formation, and tissue regeneration. These distinctive biological properties could improve periodontal healing outcomes when used in combination with non-surgical periodontal treatment(13, 14).

Furthermore, albumin is an abundant plasma protein in the human body that plays an integral role in maintaining oncotic pressure, transporting endogenous and exogenous substances, and regulating the inflammatory response. In regenerative therapies, albumin has recently gained attention due to its outstanding biocompatibility, low immunogenicity, and prolonged degradation profile. Additionally, albumin has shown the ability to stabilize and preserve biologically active molecules, allowing sustained release of growth factors and prolonged biological activity within healing tissue sites. These advantageous biological properties have encouraged its use in periodontal regenerative applications with the aim of improving wound healing and tissue repair(15).

Albumin based concentrated growth factors has more recently emerged as a modified platelet concentrate characterized by prolonged structural stability and delayed degradation compared with conventional platelet concentrates. Alb-CGFs is prepared through incorporation of albumin into the fibrin matrix, allowing sustained release of growth factors over an extended period(16). This prolonged biological activity could support enhanced stimulus response and improve health within periodontal tissues. Furthermore, Alb-CGFs has demonstrated favourable biocompatibility and handling characteristics, making it a promising adjunctive material in periodontal therapy(17).

Although Alb-CGFs have demonstrated encouraging regenerative potential, limited evidence is currently available regarding its comparative effects on periodontal clinical improvement following non-surgical periodontal therapy. Therefore, the current study was conducted to evaluate the percentage change in clinical periodontal parameters following adjunctive use of albumin based concentrated growth factorsin patients with stage III periodontitis.

Methods

Inclusion criteria

The present study included medically healthy male and female participants aged between 25 and 45 years who were diagnosed with stage III grade A periodontitis. Eligible participants exhibited clinical attachment loss (CAL) ≥5 mm, pocket depth (PD) ≥6 mm, bleeding on probing (BoP) ≥30%, in addition to radiographic evidence of bone loss extending to the middle third of the root. Furthermore, only individuals who could understand, read, and sign the informed consent form were enrolled in the study.

Exclusion criteria included

Participants were excluded if they were pregnant or lactating, used tobacco products, or had a known history of hypersensitivity to any of the medications or materials utilized in the study. Individuals who had undergone periodontal therapy within the previous 6 months or had received antibiotic therapy during the last 3 months were also excluded (18). In addition, participants who were unable or unwilling to comply with proper oral hygiene instructions and maintenance protocols were not considered eligible for inclusion in the study.

Ethical approval

The current study was conducted at Mansoura University's Department of Oral Medicine and Periodontology, Faculty of Dentistry. Before beginning the investigation, the Mansoura University ethical committee provided ethical permission with ID A03010250M, and clinical trial registration was completed with ID NCT07081230. The sample size was determined using the G-power program from a prior study (Al-Rihaymee and Mahmood, 2023), and 20 participants were included (19).

Study Design

The current investigation was designed as a randomized controlled clinical trial. Before the launch of the study, participants were randomly assigned into their respective groups by a blindedstatisticianby the use ofcomputer generated randomization tables. All patients received a brief explanation regarding the study protocol and were asked to provide a written informed consent prior to enrollment. Thereafter, the patients were distributed into two equal groups, with each group containing 10 patients.

- Group I:Participantswere treated with SRP therapy followed by the application ofAlb-CGFs gel.
- Group II: Participants were treated with SRP therapy only.

Clinical Parameters Evaluated

Periodontal clinical parameters includingclinical attachment level (CAL), plaque index (PI), bleeding on probing (BoP) as well as periodontal pocket depth (PD) were assessed at baseline, 1 and 3 months post treatmentutilizinga UNC15 probe[1].

ALB-CGFs preparation

The gel was prepared by collecting blood in 9 mL tubes without additives[2], followed by centrifugation[3] at 700g for 8 minutes. After centrifugation, the first 2 mL of platelet-poor plasma (PPP) were aspirated using a syringe and heated at 75°C for 10 minutes to obtain the albumin gel. The heated PPP was subsequently cooled in a

[1]Sedra Dent UNC periodontal probe with 15mm graduated tip ,Sedra Dent Solutions, 31 El-Rashidy st. Qasr Al-Ainy, Cairo, Egypt.
[2]No additive collection tubes 149430,VACUTEST KIMA, Viadell'industria12,35020-Arzergrande (PD) Italy
[3]Horizontal centrifuge DM0424, DLAB SCIENTIFIC CO.,LTD.No.31, Yu'an Road, Beijing Airport Economic Core Zone, Shunyi District,Beijing101318,China

light-protected cooling storage bag. Meanwhile, the remaining blood portions were also maintained in a cooling storage bag, and the liquid phase concentrated growth factors (LPCGF) were isolated from the buffy coat layer. Finally, the albumin gel was mixed with LPCGF using a female–female[4] connector in a 1:2 ratio(20).

Procedures

Following SRP, chosen periodontal pockets diagnosed with stage III periodontitis grade A, exhibiting PD of 5-7 mm and clinical attachment loss (CAL) greater than 5 mm in the test group were subgingivallyinjected with ALB-CGFs gel. The prepared gel mixture was delivered into the periodontal pocket by a disposable plastic syringe equipped with a flexible metal tip(21), ensuring the complete filling of the pocket from its base. Care was taken throughout the application procedure to minimize trauma and prevent damage to surrounding tissues.

Prior to gel administration, the treated area was isolated using cotton rolls to maintain field dryness and reduce contamination. After the procedure, participants were instructed to refrain from eating or drinking for at least two hours. In addition, participants were advised to avoid brushing or using dental floss in the treated sites for a minimum of 12 hours post therapy.

Statistical analysis

Statistical analysis was carried out using IBM SPSS software package version 27.0 (Armonk, NY: IBM Corp., 2020). Categorical data were expressed as frequencies and percentages, while quantitative variables were tested for normality using the Shapiro–Wilk test. Normally distributed quantitative data were presented as mean ± standard deviation (SD), whereas non-normally distributed data were expressed as median, interquartile range (IQR), and minimum–maximum values. Statistical significance was considered at $p < 0.05$, and all tests were two-tailed.The Chi-square test was used to compare categorical variables, while Fisher's Exact test was applied when appropriate. Independent samples t-test was used for comparison between two groups for normally distributed quantitative variables, whereas the Mann–Whitney U test was used for non-normally distributed quantitative variables

Results

As indicated by the statistical analysis, there were no statistically significant differences between the Alb-CGFs and control groups regarding demographic characteristics, as shown in Table (1), Figures (1,2). The distribution of sex was comparable among the groups, where males represented 50% of the Alb-CGFs group, and 40% of the control group, while females represented 50%, and 60% of the groups, respectively ($\chi^2 = 0.202$, $p = 1.000$). Similarly, age showed no statistically significant difference among the groups ($t = 1.301$, $p = 0.210$). The mean age was 37.60 ± 5.36 years in the Alb-CGFs group, and 34.60 ± 4.95 years in the control group.

4 Female/Female Luer Lock Adapter, Leader Life Sciences, Laboratory Complex, Dubai Science Park Office #219, 2nd Floor, Dubai, UAE

The percentage change in plaque index (PI) between the Alb-CGFs and control groups at different evaluation intervals is presented in Table (2), Figures (3,4). No statistically significant differences were observed between the two groups at any evaluation interval. From baseline to T1, the percentage reduction was 51.51 ± 9.49 in the Alb-CGFs group, and 51.87 ± 6.53 in the control group(t = 0.099, p = 0.923).Likewise, from baseline to T3, the percentage changes were 60.55 ± 4.08, and 64.61 ± 6.21, respectively, with no statistically significant differences between both groups (t = 1.184, p = 0.252). The interval between T1 and T3 also demonstrated no significant difference among groups, with percentage changes of 16.39 ± 14.64, and 25.09 ± 18.04, respectively (t = 1.726, p = 0.101).

The percentage change in bleeding on probing (BoP) between the Alb-CGFs and control groups at different evaluation intervals is illustrated in Table (2), Figures (5,6). The percentage change from baseline to T1 did not significantly differ between the groups, recording values of 66.11 ± 8.56 for theAlb-CGFsgroup, and 64.58 ± 6.68 for the control group(t = 0.446, p = 0.661).Likewise, from baseline to T3, the Alb-CGFsgroup demonstrated greater percentage reduction in BoP values (71.41 ± 3.47) compared with the control group (67.50 ± 3.59), although the difference between both groups was not statistically significant (t = 1.060, p = 0.303). However, from T1 to T3, the Alb-CGFs group demonstrated significantly greater median percentage reduction in BoP values [8.68 (0.0–28.57)] compared with the control group [1.80 (0.0–5.0)] (U = 20.50, p = 0.023).

The percentage change in pocket depth (PD) between the Alb-CGFs and control groups at different evaluation intervals is shown in Table (2), Figures (7,8). From baseline to T1, the Alb-CGFsgroup demonstrated greater median percentage reduction in PD values [34.29% (20.0–50.0)] compared with the control group [20.0% (16.67–20.0)], although the difference between both groups did not reach statistical significance (U = 26.00, p = 0.075). Likewise, from baseline to T3, the Alb-CGFs group exhibited greater median percentage reduction in PD values [50.0% (40.0–57.14)] compared with the control group [33.33% (20.0–33.33)], however,the difference was not statistically significant (U = 38.50, p = 0.393). Conversely, from T1 to T3, the Alb-CGFsgroup demonstrated significantly greater median percentage reduction in PD values [12.50% (0.0–40.0)] compared with the control group [10.0% (0.0–20.0)] (U = 3.000, p < 0.001).

The percentage change in clinical attachment level (CAL) between the Alb-CGFs and control groups at different evaluation intervals is highlighted in Table (2), Figures (9,10). From baseline to T1, the Alb-CGFs group demonstrated greater median percentage gain in CAL values [30.95% (16.67–42.86)] compared with the control group [16.67% (14.29–20.0)] (U = 23.50, p = 0.043). From baseline to T3, the Alb-CGFs group exhibited significantly greater mean percentage gain in CAL values (50.24 ± 13.11) compared with the control group (24.57 ± 7.72) (t = 2.784, p = 0.012). Furthermore, from T1 to T3, the Alb-CGFs group demonstrated significantly

greater median percentage gain in CAL [25.0% (16.67–40.0)] compared with the control group [0.0% (0.0–20.0)] (U = 5.500, p < 0.001).

Discussion

The present investigation was conducted to assess the therapeutic potential of adjunctive Alb-CGFs therapy in improving the percentage of change of clinical periodontal parameters following non-surgical periodontal therapy in stage III periodontitis patients. The evaluated clinical parameters included plaque index (PI), bleeding on probing (BoP), pocket depth (PD), and clinical attachment level (CAL). The findings demonstrated that all treatment modalities resulted in clinical improvement over time; however, the adjunctive use of Alb-CGFsshowed superior percentage changes in several periodontal clinical indices compared with the control group.

The absence of statistically significant differences between the Alb-CGFs and control groups regarding demographic characteristics indicates baseline comparability among participants and minimizes the possibility that demographic variables influenced the observed clinical outcomes. In addition, the comparable baseline periodontal conditions between the groups suggest that the differences in percentage change of clinical indices were primarily related to the therapeutic intervention.

Regarding plaque index, both groups demonstrated marked percentage reduction throughout the study period, with no statistically significant differences between the Alb-CGFs and control groups. This finding could indicate that the improvement in plaque control was mainly attributed to effective mechanical debridement and reinforcement of oral hygiene measures rather than the adjunctive biomaterial itself.This agreed with the investigation conducted by Wallin et al., who reported that there were no significant differences between the test and the control groupin terms of PI although both groups showed significant reduction in PI (22).Thus, highlighting that SRP effectively disrupts the dysbiotic subgingival biofilm and reduces microbial accumulation, resulting in improvement of periodontal status and plaque control in both groups. Despite the comparable percentage reduction in PI, the Alb-CGFs group demonstrated superior outcomes in other periodontal clinical indices.

Concerning bleeding on probing, the Alb-CGFs group exhibited greater percentage of reduction compared with the control group, particularly during the T1-T3 interval. This favourable outcome could be attributed to the biological properties of albumin, which could support tissue healing and prolong the release of biologically active molecules within periodontal tissues(15). The sustained release behaviour of albumin could contribute to prolonged anti-inflammatory activity and improved periodontal health (23).

Similarly, greater percentage reductions in pocket depth were noted in the Alb-CGFs group compared with the control group, particularly during the T1-T3 interval. The Alb-CGFs group demonstrated greater percentage reduction in PD at both one and

three months post-therapy, suggesting enhanced periodontal healing and improved resolution of periodontal pockets. These findings could be related to the structural stability and slower degradation kinetics of albumin, which could permit prolonged biological activity and sustained support for periodontal tissue healing(24).This is further supported by the investigation performed byKumari et al., which highlighted Albumin enriched platelet rich fibrins ability to improve clinical outcomes and provide a preferable woundhealing effect (25).

Regarding clinical attachment level, the Alb-CGFs group demonstrated significantly greater percentage gain in CAL compared with the control group throughout the follow-up period. The enhanced percentage gain in CAL could reflect improved connective tissue healing and periodontal tissue reattachment following adjunctive Alb-CGFstherapy. Albumin-based biomaterials possess excellent biocompatibility and could provide a scaffold-like effect that supports tissue remodelling and maturation over extended periods(17).

The favourable clinical outcomes observed in the Alb-CGFs group could be explained by its ability to act as a biological scaffold capable of supporting tissue repair and prolonging the activity of biologicalmolecules within periodontal tissues. In addition, albumin demonstrates slow degradation behaviour, which could contribute to sustained healing effects and improved periodontal stability over time(20).

The findings of the current investigation support the potential role of adjunctive Alb-CGFs therapy in enhancing the percentage improvement of periodontal clinical parameters following non-surgical periodontal therapy. The significant percentage of reduction observed in bleeding on probing and pocket depth, as well as the greater percentage gain in clinical attachment level, suggest that adjunctive Alb-CGFs therapy could improve periodontal wound healing and clinical periodontal stability beyond that achieved with conventional therapy alone.

Although the current study findings are promising, several studies in the literature have highlighted contradictory findings.Oliveira et al., and Christodoulides et al., showed no clinically significant differences following non-surgical periodontal therapy performed with or without adjunctive therapeutic modalities. Such discrepancies could be attributed to variations in disease activity, biomaterial preparation, application methods and the duration of follow-up visits. Furthermore, differences in platelet concentrate preparation procedures and the quality of obtained blood could also affect the therapeutic efficacy (26, 27).

The findings of the current investigation illustrate that albumin-based concentrated growth factors could serve as an effective adjunctive modality in the treatment of periodontitis due to its excellent biocompatibility, prolonged therapeutic effect, and simple clinical handling characteristics.

Limitations

the present investigation was limited by the limited sample size and brief follow-up duration, which could limit the long-term interpretation of the findings. Therefore, further studies with larger sample sizes and extended follow-up periods are recommended to better evaluate the long-term clinical efficacy of adjunctive Alb-CGFs therapy in periodontal treatment.

Conclusion

The findings of the current study support the potential role of adjunctive biomaterial-based therapies in enhancing the percentage improvement of periodontal clinical indices following non-surgical periodontal therapy. The significant percentage reduction observed in BoP and PD, as well as the greater percentage gain in CAL, suggest that Alb-CGFstherapycould improve periodontal wound healing and clinical periodontal stability beyond that achieved with conventional therapy alone.

Acknowledgment

Nil.

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Nil.

Conflict of Interest

None.

Contributions

All authors contributed equally to the conception and design of the study, data collection, statistical analysis, interpretation of the results, manuscript preparation, and final approval of the submitted version of the manuscript.

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TABLES

Table (1): Comparison between the two studied groups according to demographic data

	Alb-CGFs (n = 10)		Control (n = 10)		Test of Sig.	p
	No.	%	No.	%		
Sex						
Male	5	50.0	4	40.0	χ^2= 0.202	FE p= 1.000
Female	5	50.0	6	60.0		
Age (years)						
Min. – Max.	25.0 – 44.0		27.0 – 43.0			
Mean ± SD.	37.60 ± 5.36		34.60 ± 4.95		t= 1.301	0.210
Median (IQR)	39.0(36.0 – 41.0)		33.0(31.0 – 38.0)			

IQR: **Inter quartile range** SD: **Standard deviation** t: **Student t-test**

χ^2: **Chi square test** FE: **Fisher Exact test**

p: p value for comparing between the twostudied groups

Table (2): Comparison between the twostudied groups according to Percentage of change for clinical indices

Clinical indices	Percentage of change	Alb-CGFs (n = 10)	Control (n = 10)	Test of Sig.	p
PI	Baseline-T1	51.51 ± 9.49	51.87 ± 6.53	t=0.099	0.923
	Baseline-T3	60.55 ± 4.08	64.61 ± 6.21	t=1.184	0.252
	T1-T3	16.39 ± 14.64	25.09 ± 18.04	t=1.726	0.101
BOP	Baseline-T1	66.11 ± 8.56	64.58 ± 6.68	t=0.446	0.661
	Baseline-T3	71.41± 3.47	67.50 ± 3.59	t=1.060	0.303
	T1-T3	8.68 (0.0 – 28.57)	1.80 (0.0 – 5.0)	U=20.50*	0.023*
PD	Baseline-T1	34.29(20.0 – 50.0)	20.0(16.67 – 20.0)	U=26.00	0.075
	Baseline-T3	50.0(40.0 – 57.14)	33.33(20.0 – 33.33)	U=38.50	0.393
	T1-T3	12.50 (0.0 – 40.0)	10.0 (0.0 – 20.0)	U=3.000*	<0.001*
CAL	Baseline-T1	30.95(16.67 – 42.86)	16.67(14.29 – 20.0)	U=23.50*	0.043*
	Baseline-T3	50.24 ± 13.11	24.57 ± 7.72	t=2.784*	0.012*
	T1-T3	25.0(16.67 – 40.0)	0.0(0.0 – 20.0)	U=5.500*	<0.001*

Normally distributed data was expressed in Mean ±Standard deviation (SD.) **while** non-normally distributed Data was expressed in Median with Inter quartile range (IQR)

t**: Student t-test** U: **Mann Whitney test**

p: p value for comparing between the twostudied groups

FIGURES

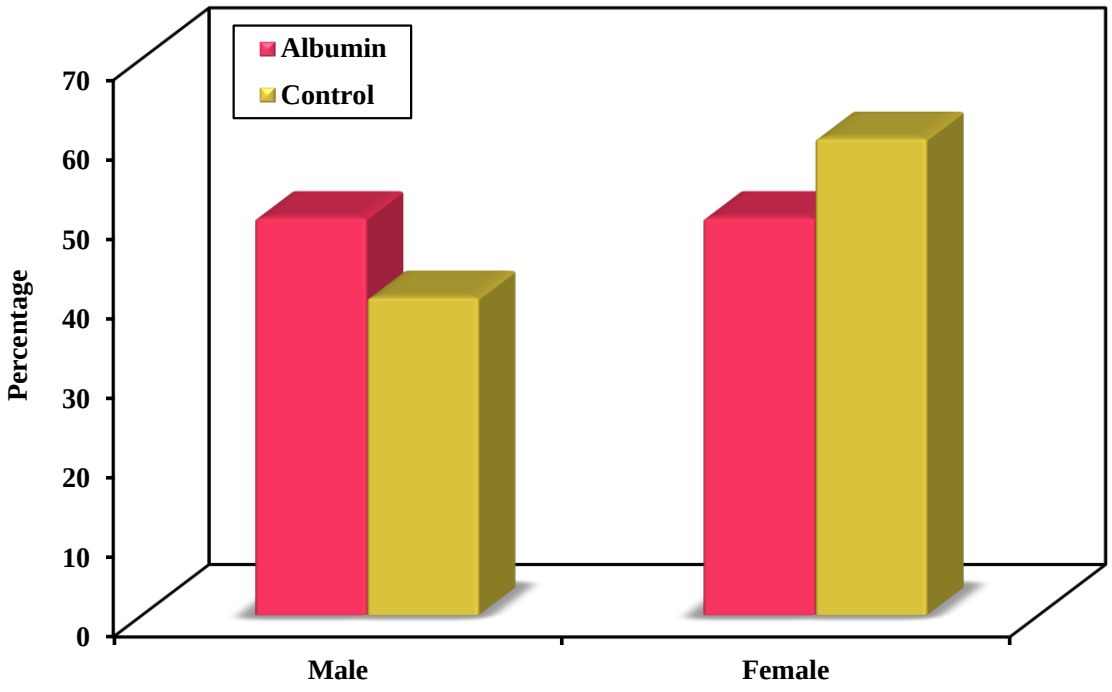

Figure (1): Comparison between the two studied groups according to sex

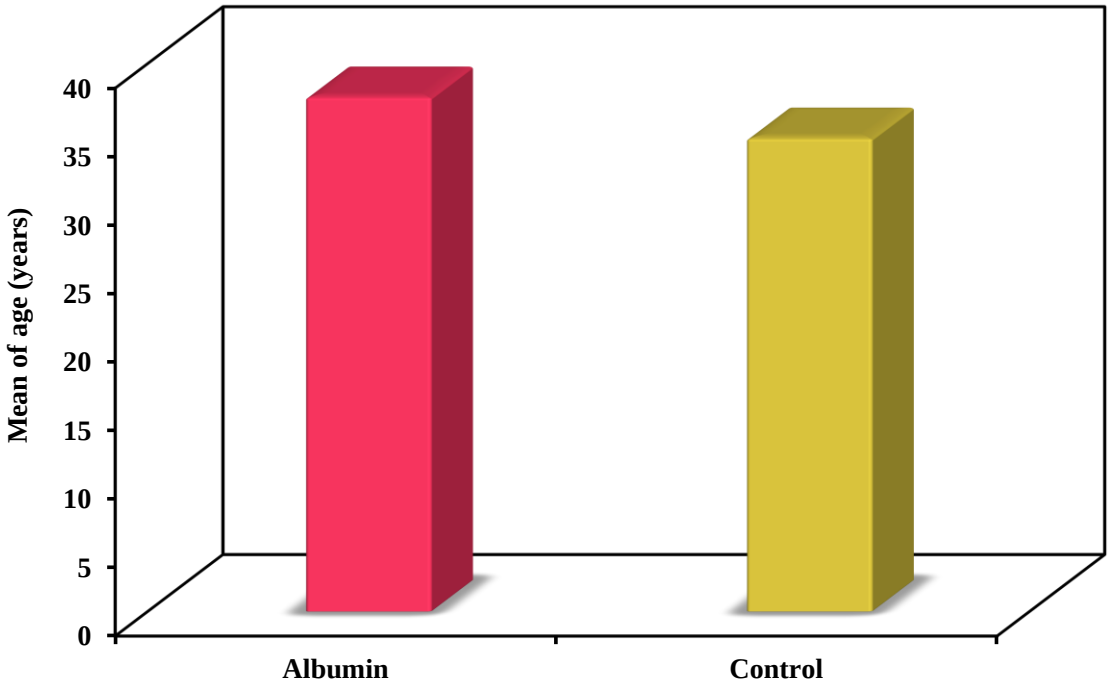

Figure (2): Comparison between the two studied groups according to age (years)

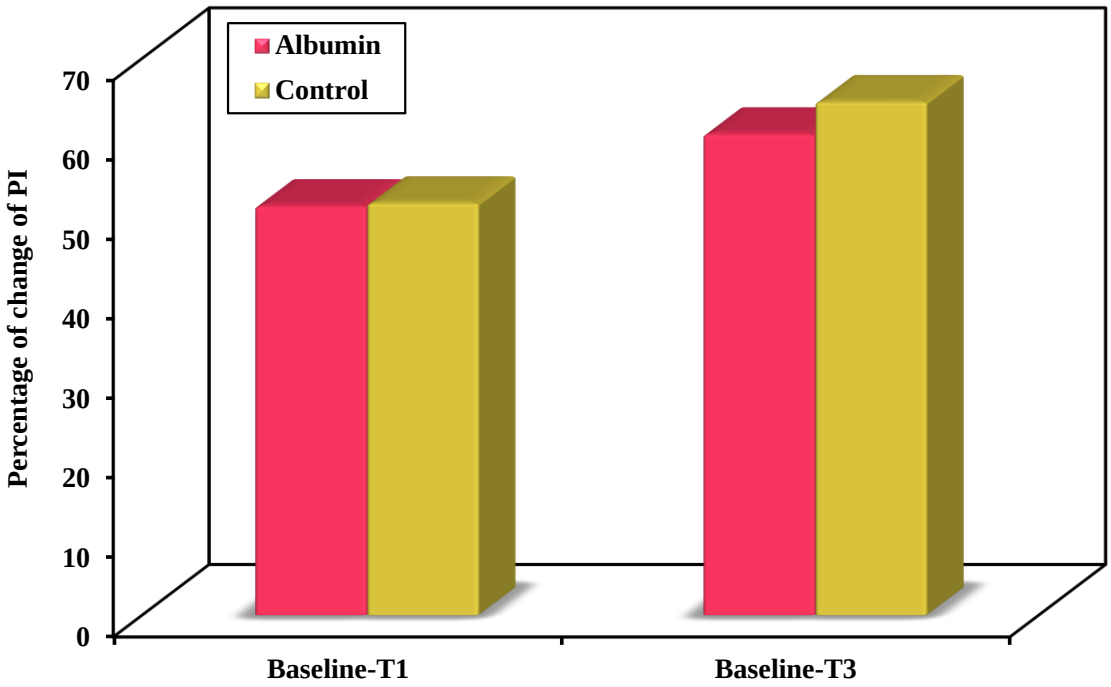

Figure (3): Comparison between the twostudied groups according to Percentage of change for PI

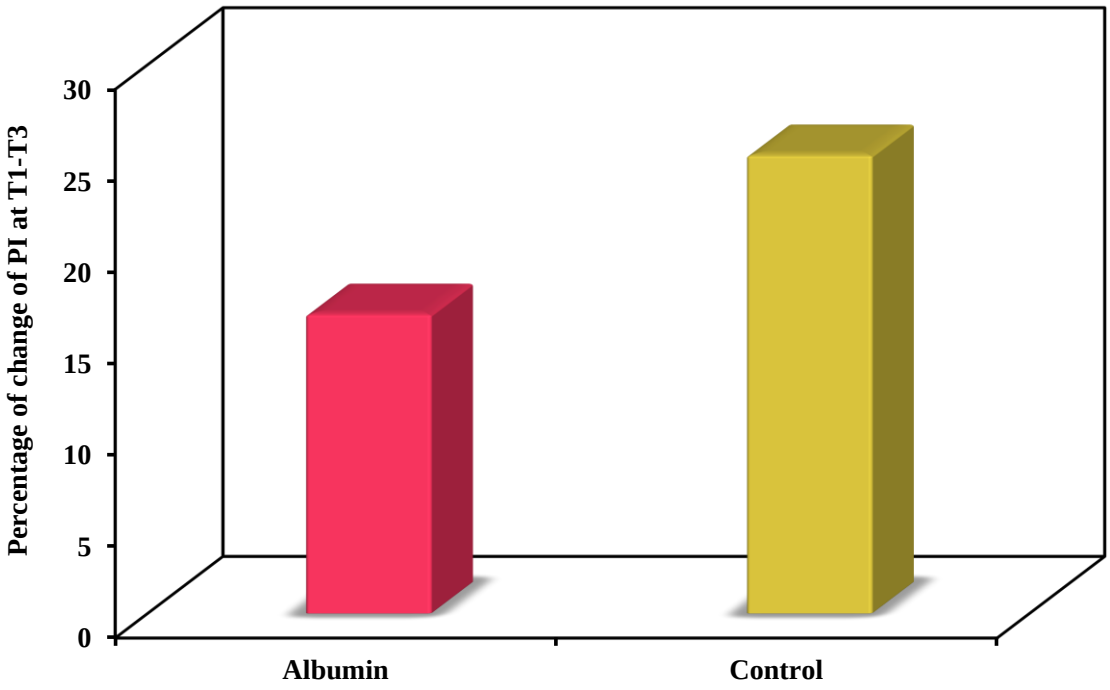

Figure (4): Comparison between the twostudied groups according to Percentage of change for PI at T1-T3

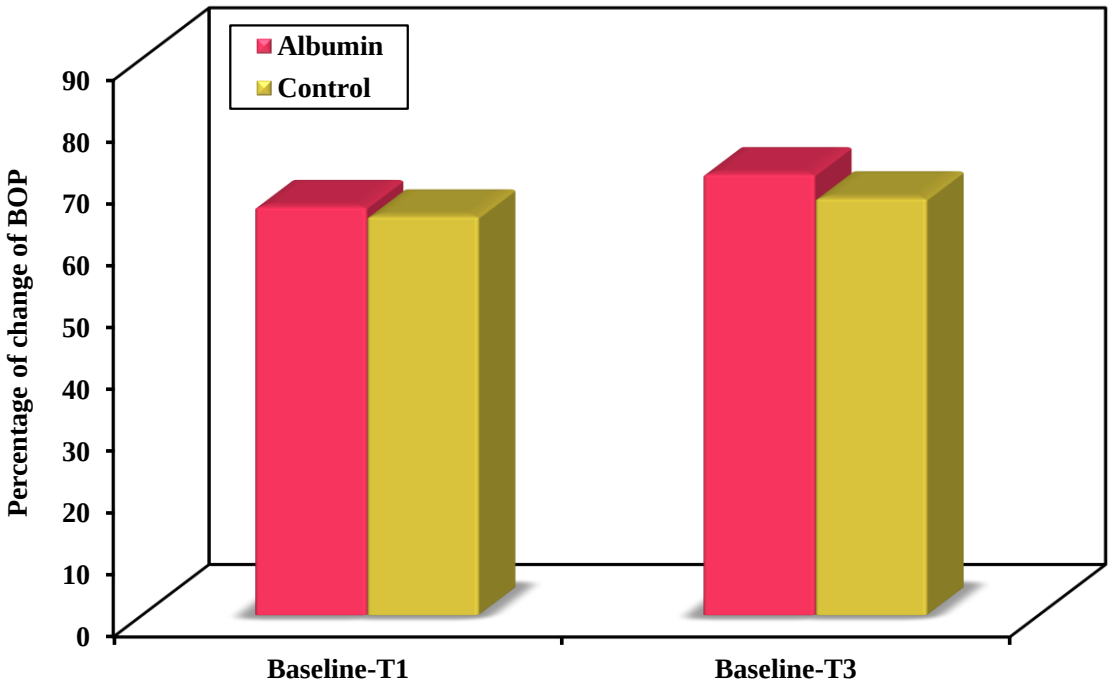

Figure (5): Comparison between the two studied groups according to Percentage of change for BOP

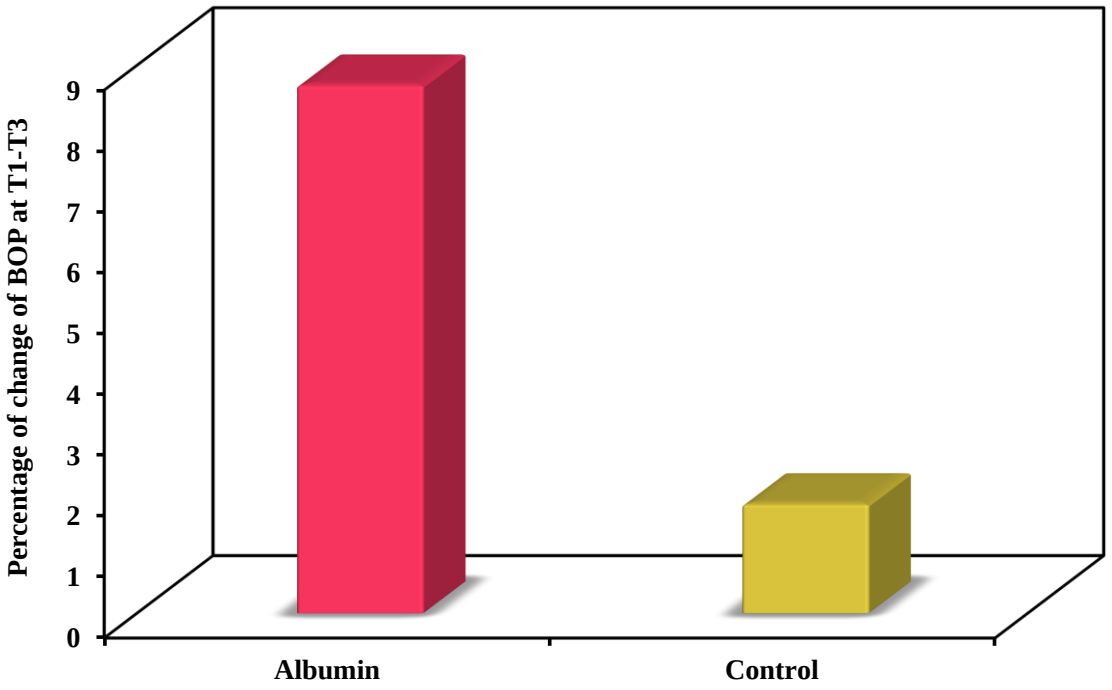

Figure (6): Comparison between the two studied groups according to Percentage of change for BOP at T1-T3

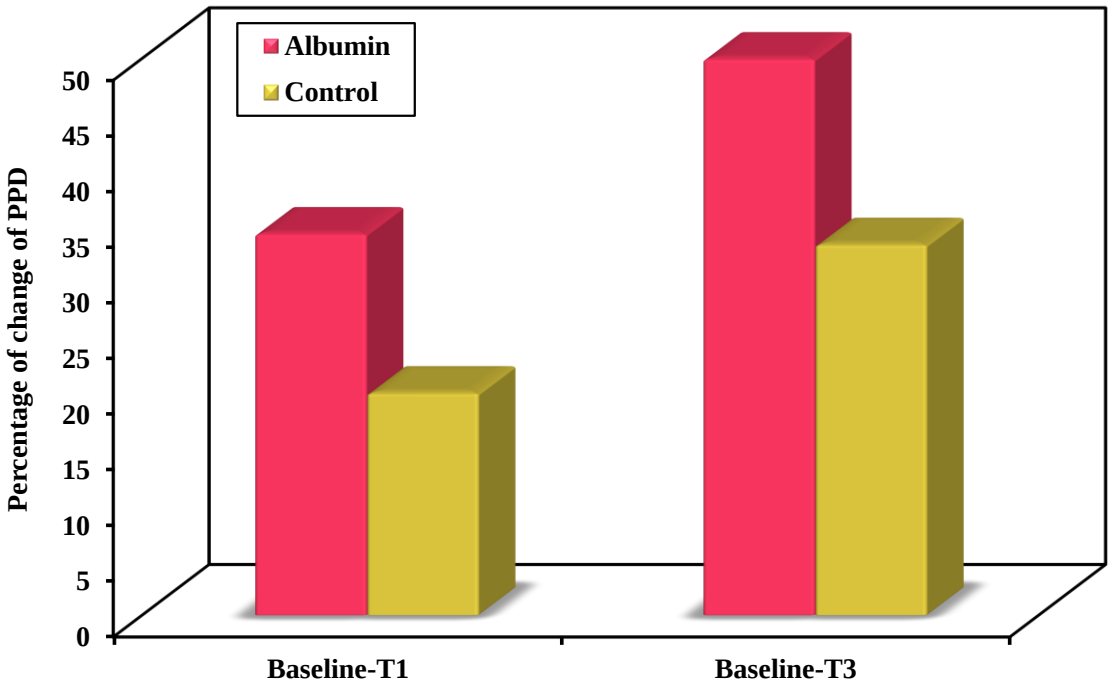

Figure (7): Comparison between the twostudied groups according to Percentage of change for PD

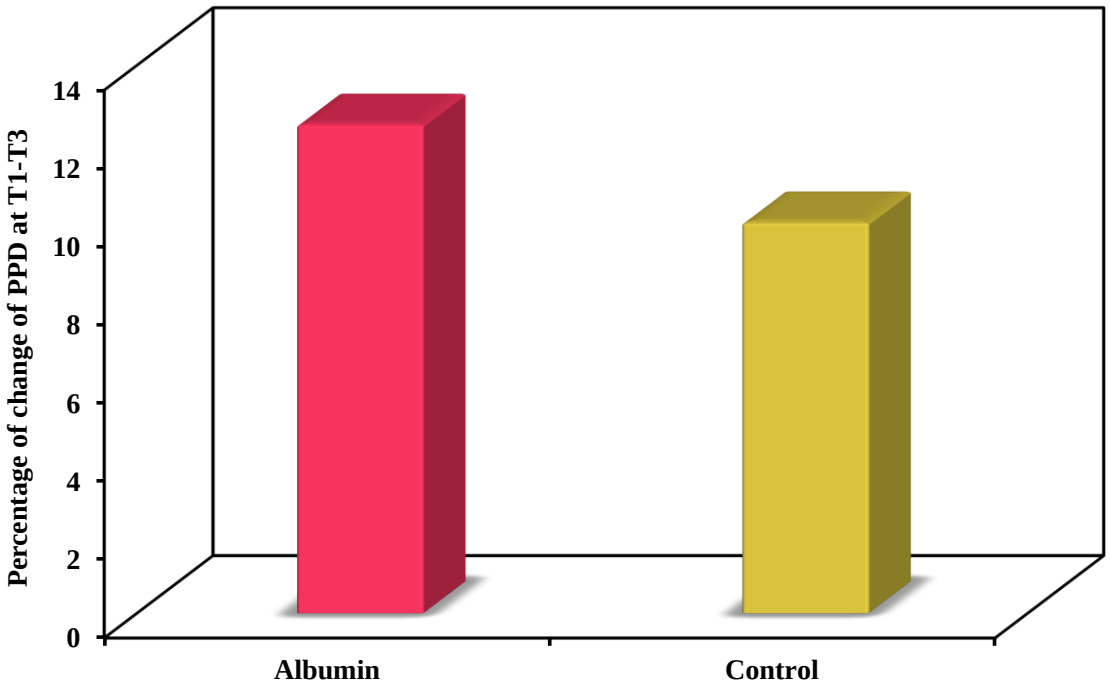

Figure (8): Comparison between the twostudied groups according to Percentage of change for PD at T1-T3

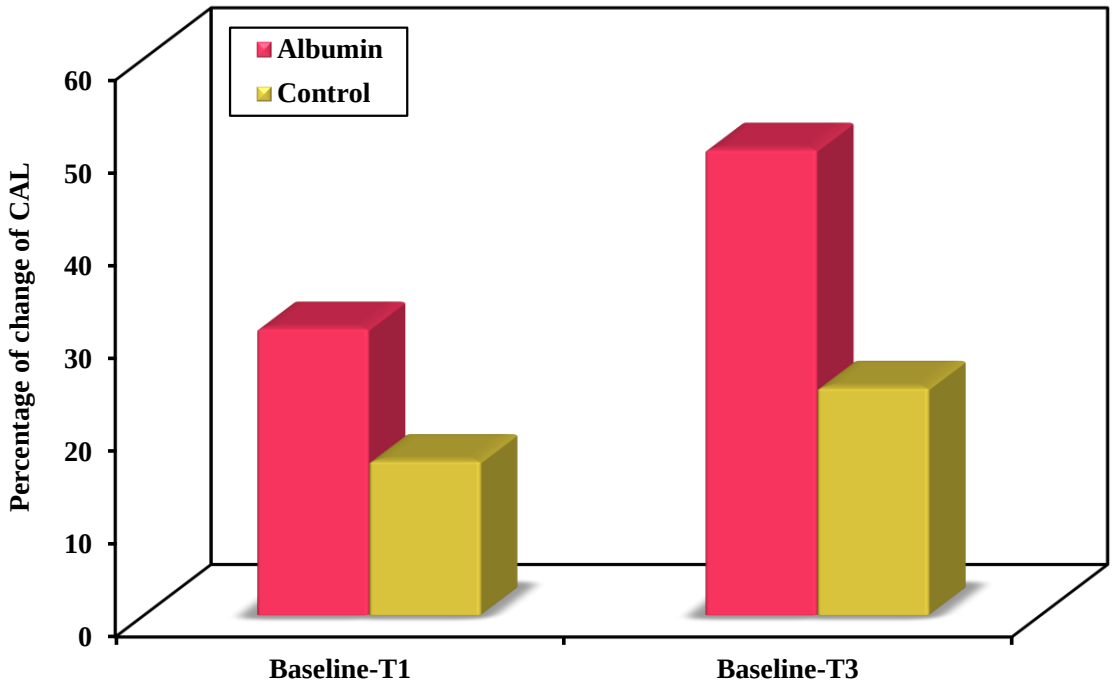

Figure (9): Comparison between the twostudied groups according to Percentage of change for CAL

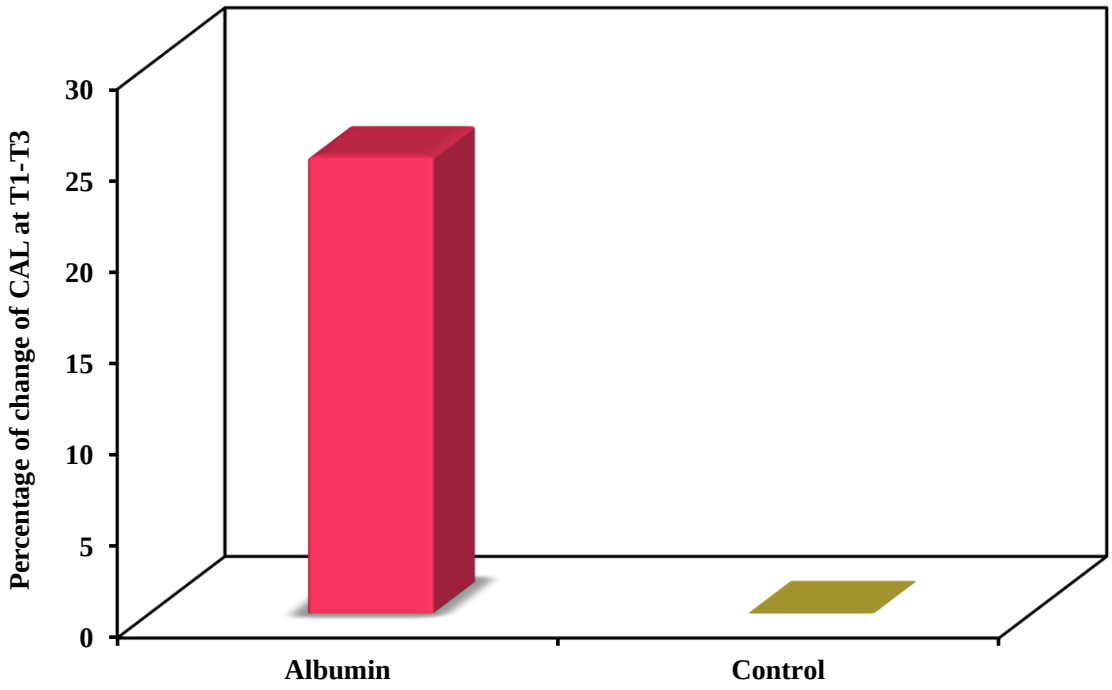

Figure (10): Comparison between the twostudied groups according to Percentage of change for CAL at T1-T3