

Examining the Relationship between Hypertension, Serum Homocysteine, Lipid Profile, and Serum Vitamin B₁₂ Levels in Patients with Retinal Vein Occlusion and Their Interconnections

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Abstract:

Background: Central and branch retinal vein occlusions (CRVO and BRVO) cause considerable ocular morbidity. Homocysteine levels, along with atherosclerosis, systemic hypertension, and age, have been discussed as risk factors. Homocysteine, a sulfur-containing nonprotein amino acid, may cause retinal vein blockage by damaging arteries and forming a thrombus.

Methods: This retrospective case-control study examined the relationship between hyperhomocysteinemia, retinal vascular occlusion, and vitamin B₁₂ levels. There were 100 participants: 50 retinal vein occlusion patients and 50 age- and sex-matched controls. Statistical approaches were used to analyze blood homocysteine, lipid, vitamin B₁₂, and hypertension data.

Results: Hyperhomocysteinemia (>15 umol/L) was linked to retinal vein occlusion ($p < 0.05$), suggesting a potential risk factor. Serum vitamin B₁₂ levels did not significantly predict retinal vein occlusion. Further research showed a substantial association between case group homocysteine and vitamin B₁₂ levels, suggesting a possible interaction. High blood pressure (>140 mmHg) was linked to retinal vein occlusion ($p < 0.001$), indicating hypertension as a substantial risk factor.

Conclusion: Elevated homocysteine levels could be a controllable risk factor for retinal vein occlusive disorders, indicating the possible advantages of interventions like vitamin B₁₂ supplementation. More research is required to understand the intricate connections among homocysteine, vitamin B₁₂, and other contributing factors in the development of retinal vein occlusion.

Recommendation: According to the findings, practitioners should monitor serum homocysteine levels in retinal vein occlusion patients and consider dietary changes and vitamin B₁₂ supplements. Hypertension management may also reduce retinal vein occlusion risk.

Keywords: Retinal Vein Occlusion, hyperhomocysteinemia, Vitamin B₁₂, Hypertension.

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Introduction

Retinal venous occlusive disorders are a major contributor to eye health issues [1]. Central retinal vein occlusion (CRVO) and hemi-central retinal vein occlusion (HCRVO) have a common cause, leading to vision-threatening conditions. They occur due to the development of a blood clot within the lamina cribrosa. Lately, there has been a focus

on elevated homocysteine levels in the bloodstream as an extra risk factor, in addition to atherosclerosis, systemic hypertension, and increasing age. Homocysteine, a sulfur-containing, nonprotein amino acid, is produced by the body from methionine. There are multiple reasons why serum homocysteine levels can increase, such as

genetic mutations in enzymes related to homocysteine processing, lack of essential vitamins, health conditions like chronic renal failure, specific medications, pregnancy, and smoking. High levels of homocysteine are linked to atherogenic and prothrombotic effects. Damage to blood vessels related to homocysteine has been associated with vascular changes including thickening of the intima, disruption of the elastic lamina, hypertrophy of smooth muscles, and the formation of occlusive thrombus [1, 2].

Damage caused by homocysteine has been linked to different changes in blood vessels, such as thickening of the intima, disruption of the elastic lamina, smooth muscle hypertrophy, and the development of occlusive thrombus. There have been many studies examining this relationship. Some have found a link between hyperhomocysteinemia and retinal vein occlusion, while others have not [3,4,5,6,7].

It is still uncertain how vitamin B₁₂ and folate deficiencies affect this relationship, potentially altering the outcomes [8,9]. However, Lahiri et al. and Narayanasamy et al. found a notable reverse relationship between serum homocysteine levels and levels of vitamin B₁₂ and folate [5,10].

Therefore, hyperhomocysteinemia may be a controllable risk factor for retinal venous occlusive disorders. Tackling this risk factor could be done through a straightforward intervention, like adding vitamin B₁₂ and folate supplementation to the diet [11,12].

We conducted a study to explore the relationship between hyperhomocysteinemia and central retinal vein occlusion (CRVO) and branch retinal vein occlusion (BRVO), as well as the link between serum homocysteine levels and vitamin B₁₂ levels in the participants. Furthermore, our goal was to investigate the relationship between hyperhomocysteinemia and vitamin B₁₂ deficiency.

Materials and Methods

This retrospective account outlines the methodology used to study the connections among hypertension, serum homocysteine, lipid profile, and serum vitamin B₁₂ levels in patients with retinal vein occlusion (RVO) and to analyze how these parameters relate to RVO pathology. The research took place from August 2022 to March 2023 at Mata Gujri Memorial Medical College and LSK Hospital in Kishanganj, Bihar.

Study Design

The study utilized a case-control research design with 100 participants, evenly split into two groups: 50 cases with diagnosed retinal vein occlusion and 50 controls without any retinal or vascular issues, matched by age and sex. This methodology allowed

for the analysis of potential variations and connections between the two groups regarding the study parameters.

Study Setting

The study was conducted in a controlled clinical setting at Mata Gujri Memorial Medical College and LSK Hospital, utilizing the hospital's medical records and laboratory capabilities for data gathering and analysis.

Participants

Participants were selected according to precise criteria for inclusion and exclusion. The case group consisted of individuals diagnosed with retinal vein blockage, which was validated by ophthalmologic examination and retinal imaging. The control group consisted of individuals without any prior retinal disorders or major vascular pathologies, chosen from the general population or hospital staff. Participants were excluded if they had a history of hematologic abnormalities, were using vitamin B supplements, or had renal or liver conditions that could affect the outcomes.

Bias

Participants were selected according to predetermined criteria to reduce selection bias, with controls paired with cases based on age and gender. Information bias was reduced by implementing standardized data collection procedures and ensuring that laboratory personnel were unaware of the participants' group assignment.

Variables

The main variables studied were serum homocysteine levels, lipid profile (total cholesterol, LDL, HDL, and triglycerides), serum vitamin B₁₂ levels, and the occurrence of hypertension. The factors were selected for their possible significance in the development of retinal vein occlusion.

Data Collection

The data collection process consisted of two steps: (1) Examining medical records for demographic data, medical history, and clinical observations about RVO. (2) Analysing blood samples to determine serum homocysteine, lipid profile, and vitamin B₁₂ levels. Blood pressure readings were recorded during clinical appointments to see if hypertension was present.

Procedure

Upon enrollment, all participants underwent a comprehensive clinical evaluation, including a detailed ophthalmologic examination for cases and controls. Blood samples were collected following a 12-hour fasting period and analyzed using standardized biochemical methods to ensure consistency and reliability of the results.

Statistical Analysis

Analysis was done with statistical software. Subject demographics and clinical features were summarised using descriptive statistics. To compare cases and controls, chi-square and t-tests were performed for categorical and continuous data. The connections between retinal vein blockage, serum homocysteine, lipid profile, vitamin B₁₂ levels, and hypertension were examined using Pearson's or Spearman's correlation coefficients. A significant difference or relationship was indicated by a p-value below 0.05.

This research was designed to shed light on the intricate relationships between systemic health indices and retinal vein occlusion, providing an important understanding of its pathogenesis and possible treatment targets.

Results

The research carried out at Mata Gujri Memorial Medical College and LSK Hospital in Kishanganj, Bihar, offered valuable information across different aspects. The analysis of the 100 participants' ages revealed a significant number falling within the middle-aged to older adult categories, with the 49-59 years range being the most prominent, making up 42% of the total. The gender distribution was equal, with 25 males and 25 females, highlighting the study's dedication to gender balance. We discovered a strong link between increased homocysteine levels (>15 $\mu\text{mol/L}$) and the development of the disease being investigated. The odds ratio of 2.3021 indicates that individuals with higher homocysteine levels have more than double

the likelihood of experiencing the disease. On the other hand, Vitamin B₁₂ levels below and above 187 pg/ml did not display any significant variation in disease occurrence, as shown by an odds ratio of 0.6129 and a relative risk of 0.8065, both of which were not statistically significant.

Upon further examination of the Case Group, a notable connection was found between Vitamin B₁₂ and Homocysteine levels. The chi-squared result of 5.7647 suggests a departure from the anticipated distribution based on the null hypothesis. On the other hand, the Control Group did not show any significant correlation, as indicated by a chi-squared value of 0.2581. Moreover, a study suggested a possible connection between high lipid levels (>200 mg/dL) and the condition, but statistical significance was not achieved, as shown by an odds ratio of 1.6696 and a relative risk of 1.3750.

There were no significant findings in the association between lipid profiles and homocysteine levels in both the Case and Control Groups, indicating that a definitive relationship cannot be established based on the data at hand. There was a notable connection found between high systolic blood pressure (>140 mmHg) and the disease in question, with an odds ratio of 19.4524 and a relative risk of 3.5833, suggesting a robust relationship between elevated blood pressure and the specific condition. This thorough examination emphasizes the intricate nature of the factors linked to the disease being investigated and emphasizes the necessity for additional research in this field (Table 1-10)

Table 1: This table indicates that the majority of participants are concentrated in the age ranges of 49-59 years (42%), followed by 39-49 years (24%), and 59-69 years (26%), suggesting that the participant pool primarily consists of middle-aged to older adults.

Age Range	Frequency	Percentage
[0, 19)	0	0.0%
[19, 29)	0	0.0%
[29, 39)	2	4.0%
[39, 49)	12	24.0%
[49, 59)	21	42.0%
[59, 69)	13	26.0%
[69, 79)	2	4.0%
[79, 89)	0	0.0%
[89, 99)	0	0.0%

Table 2: This indicates an equal representation of male (M) and female (F) participants, with each gender accounting for half of the study population, thus ensuring gender parity in the analysis.

Gender	Frequency	Percentage
M	25	50.0%
F	25	50.0%

Table 3: The analysis indicates a statistically significant association between elevated homocysteine levels (>15 umol/L) and the incidence of the disease

Parameter	Value
Homocysteine >15	
Cases	34
Controls	24
Homocysteine <15	
Cases	16
Controls	26
Odds Ratio	2.3021
95% CI for OR	(1.0211 to 5.1902)
Z Statistic (OR)	2.010
Significance (OR)	P = 0.0444
Relative Risk	1.4167
95% CI for RR	(1.0028 to 2.0014)
Z Statistic (RR)	1.976
Significance (RR)	P = 0.0482

Table 4: This analysis reveals that the difference in the disease occurrence between groups with Vitamin B₁₂ levels below and above 187 pg/ml is not statistically significant.

Parameter	Value
Vit B₁₂ < 187	
Cases	25
Controls	31
Vit B₁₂ > 187	
Cases	25
Controls	19
Odds Ratio	0.6129
95% CI for OR	(0.2765 to 1.3584)
Z Statistic (OR)	1.206
Significance (OR)	P = 0.2280
Relative Risk	0.8065
95% CI for RR	(0.5671 to 1.1467)
Z Statistic (RR)	1.198
Significance (RR)	P = 0.2310

Table 5: The association between Vitamin B₁₂ levels and Homocysteine levels in the Case Group

Homocysteine Levels	Vitamin B ₁₂ < 187	Vitamin B ₁₂ > 187
>15	21	13
<15	4	12

Table 6: The analysis of the clinical data from the Control Group concerning the association between Vitamin B₁₂ levels and Homocysteine

Homocysteine Levels	Vitamin B ₁₂ < 187	Vitamin B ₁₂ > 187
>15	21	13
<15	4	12

Table 7: The association between lipid levels (>200 mg/dL and <200 mg/dL) and the case-control

Lipid Levels	Case Group	Control Group
>200 mg/dL	22	16
<200 mg/dL	28	34

Table 8: The analysis of the clinical data concerning the association between lipid profiles and homocysteine levels within the Case Group

Homocysteine Levels	Lipid >200	Lipid <200
>15	13	21
<15	9	7

Table 9: The relationship between lipid profiles and homocysteine levels

Homocysteine Levels	Lipid >200	Lipid <200
>15	13	21
<15	9	7

Table 10: The analysis of the clinical data regarding the association between systolic blood pressure (SBP) levels and the case-control status

SBP Levels	Case Group	Control Group
>140 mmHg	43	12
<140 mmHg	7	38

Discussions

The research from Mata Gujri Memorial Medical College and LSK Hospital demonstrates a thorough investigation of variables affecting a particular disease, with a particular emphasis on biochemical markers, demographic traits, and their possible correlations with disease incidence. The demographic study indicates that middle-aged to older adults are the main target audience, with the majority of participants being in the 49–59 age group. This demographic skew may indicate a trend of disease occurrence or age-related vulnerability. The study's comprehensiveness is reinforced by the gender distribution, which is evenly split to ensure a balanced perspective on the disease's impact across sexes. Interestingly, the study of biochemical markers found a strong correlation between high homocysteine levels and the illness, indicating a critical function for homocysteine as a risk factor. The complicated interplay of biochemical components in illness pathogenesis is shown by the lack of significant data linking Vitamin B₁₂ levels and the disease, as well as the uncertain relationship between lipid levels and disease incidence. The significant difference in statistical data regarding systolic blood pressure highlights the importance of hypertension as a strong risk factor, showcasing the complex nature of disease causation. This study provides important insights into specific risk factors and highlights the complex network of interactions that influence disease mechanisms, emphasizing the need for a multidisciplinary approach in future research.

Recent research has emphasized the intricate relationship among hypertension, serum homocysteine, lipid profile, and serum vitamin B₁₂ levels in individuals with retinal vein occlusion (RVO). An investigation highlighted the significance of analyzing serum homocysteine, folate, and vitamin B₁₂ levels in patients with RVO, underlining the importance of addressing these changes (2021) [13]. In a recent study, researchers did not find a significant disparity in hyperhomocysteinemia and Vitamin B₁₂ deficiency between individuals with RVO and those without, suggesting that these factors may not be standalone risk factors for RVO (2022) [14]. A study found

that high fasting homocysteine levels, low vitamin B₁₂ levels, and hypertension were associated with an increased risk of retinal vein occlusion (RVO) in patients. Specifically, central retinal vein occlusion (CRVO) was linked to these factors, while branch retinal vein occlusion (BRVO) risk was associated with hypertension alone (2014) [15]. An article discussing a case of a young patient with hyperhomocysteinemia who was treated with vitamin supplements and intravitreal bevacizumab injection showed no recurrence or new cardiovascular complications within a year, indicating a possible treatment approach (2019) [16]. In a study involving prehypertension patients, researchers discovered increased cardiovascular risk factors such as homocysteine, insulin resistance, and hs-CRP. This indicates that early identification and lifestyle changes could help reduce the risks of hypertension and cardiovascular complications. In 2014 [17]. Finally, a study was conducted on the methylenetetrahydrofolate reductase (MTHFR) gene polymorphism in Indian stroke patients. The results did not show a significant association, highlighting the intricate role of genetic factors in cardiovascular diseases (2006) [18].

Conclusion

Our research illuminates the complex connection between high homocysteine levels and retinal vein occlusive conditions, specifically central retinal vein occlusion (CRVO) and branch retinal vein occlusion (BRVO). High levels of homocysteine have been identified as a major risk factor for these conditions, indicating a possible intervention using specific methods like vitamin B₁₂ supplementation. More research is needed to understand the underlying mechanisms and effectiveness of interventions in preventing or managing retinal vein occlusion. These results highlight the significance of thorough risk evaluation and tailored management approaches in the clinical treatment of individuals prone to retinal vein occlusion.

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