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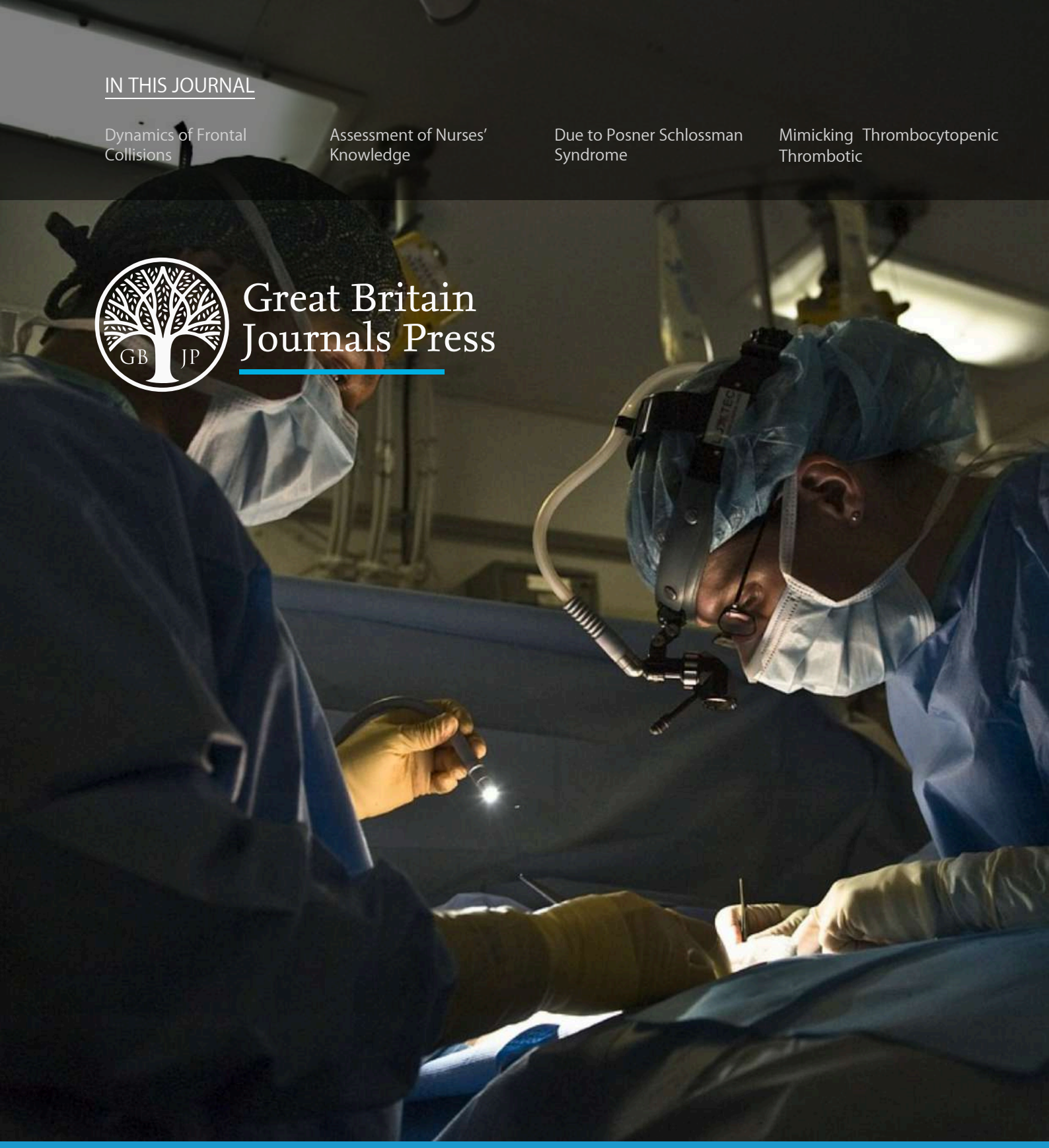

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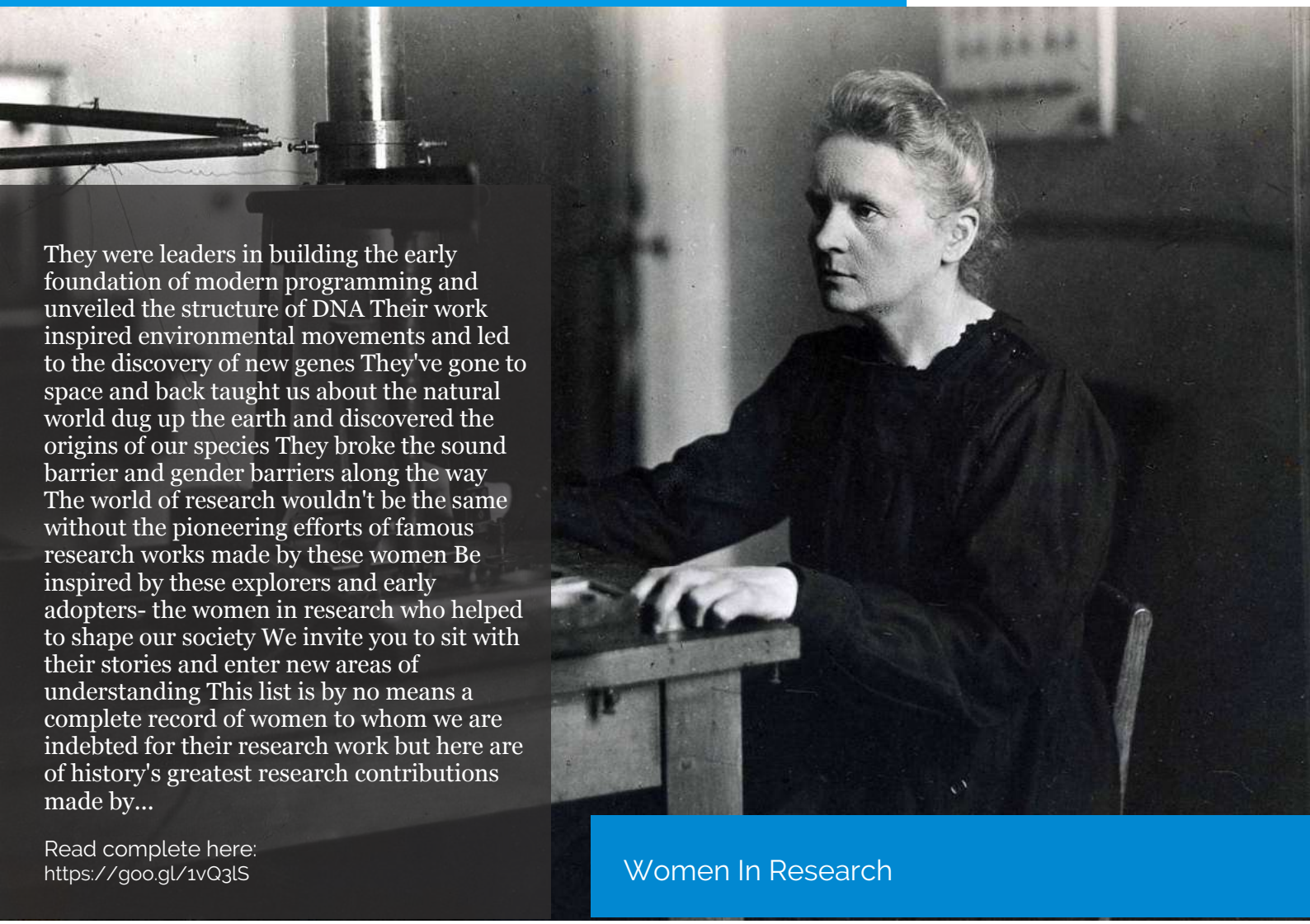

They were leaders in building the early foundation of modern programming and unveiled the structure of DNA Their work inspired environmental movements and led to the discovery of new genes They've gone to space and back taught us about the natural world dug up the earth and discovered the origins of our species They broke the sound barrier and gender barriers along the way The world of research wouldn't be the same without the pioneering efforts of famous research works made by these women Be inspired by these explorers and early adopters- the women in research who helped to shape our society We invite you to sit with their stories and enter new areas of understanding This list is by no means a complete record of women to whom we are indebted for their research work but here are of history's greatest research contributions made by...

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Severe Low Vitamin B12 Levels with Macrocytosis and Associated Hemolytic Anaemia, Mimicking Thrombocytopenic Thrombotic Purpura: A Case Report and Literature Review

Misael Bustos, MD, José Weldt, MD, Gonzalo Labarca, MD, FACP & Daniel Enos, MD

University of Concepción

ABSTRACT

The typical presentation of cobalamin deficiency is macrocytic anaemia with or without neurologic symptoms, and the most frequent cause is pernicious anaemia, an autoimmune disease against gastric parietal cells. Our case is about a 61 year-old man with neurologic symptoms, pancytopenia, and laboratory findings consistent with hemolytic microangiopathic anaemia (MAHA), like Thrombocytopenic Thrombotic Purpura (TTP). There was no response to plasma exchange (PEX) therapy, concomitant with low plasma levels of cobalamin, low reticulocyte count, macrocytosis and remarkably high lactic dehydrogenase (LDH) levels guided us to suspect a pseudo-Thrombotic Microangiopathy (Pseudo TMA). Diagnosis was confirmed with serum ADAMTS13 activity in normal ranges and the rapid clinical and laboratory improvement after cobalamin supplementation.

Keywords: vitamin b12 (cobalamin), pernicious anaemia, pseudo thrombotic microangiopathy, thrombocytopenic thrombotic purpura, plasma exchange.

Classification: NLM Code: WH140, WB400, WH170

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Misael Bustos, MD[α], José Weldt, MD[σ], Gonzalo Labarca, MD, FACP[ρ] & Daniel Enos, MD[ω]

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The typical presentation of cobalamin deficiency is macrocytic anaemia with or without neurologic symptoms, and the most frequent cause is pernicious anaemia, an autoimmune disease against gastric parietal cells. Our case is about a 61 year-old man with neurologic symptoms, pancytopenia, and laboratory findings consistent with hemolytic microangiopathic anaemia (MAHA), like Thrombocytopenic Thrombotic Purpura (TTP). There was no response to plasma exchange (PEX) therapy, concomitant with low plasma levels of cobalamin, low reticulocyte count, macrocytosis and remarkably high lactic dehydrogenase (LDH) levels guided us to suspect a pseudo-Thrombotic Microangiopathy (Pseudo TMA). Diagnosis was confirmed with serum ADAMTS13 activity in normal ranges and the rapid clinical and laboratory improvement after cobalamin supplementation. This case is remarkable for any Internal Medicine specialist to know the wide variety of presentations of cobalamin deficiency, since it is a reversible cause of bone marrow failure, and in the face of a misdiagnosis it may result in unnecessary and costly procedures.

Keywords: vitamin b12 (cobalamin), pernicious anaemia, pseudo thrombotic microangiopathy, thrombocytopenic thrombotic purpura, plasma exchange.

Authors α σ ρ ω: Department of Internal Medicine, Faculty of Medicine, University of Concepción, Concepción, Campus Los Angeles, Biobio Province, Chile. Center of Undifferentiated Medical Responsibility of Adult Healthcare Dr. Víctor Ríos Ruiz, Los Angeles, Biobio Province, Chile.

I. BACKGROUND

Cobalamin participates in cell maturation. When deficiency appears, it can lead to macrocytosis, immature nuclei and hyper segmentation in granulocytes at peripheral blood [1]. Typically, hematological findings in cobalamin deficiency are megaloblastic anemia and neurologic symptoms that could not be present [1]. The leading cause of cobalamin deficiency is pernicious anemia, an autoimmune disease characterized by antibodies against parietal cells and intrinsic factor [1,2]. However, there are other clinical pictures related to this vitamin deficiency mimicking other clinical entities such as TTP or myelodysplastic syndromes.

II. CASE PRESENTATION

A 61-year-old man, with medical record of self-limited pancytopenia interpreted as transient hypersplenism eight years before, was admitted at internal medicine ward, derived from primary care presenting a new episode of pancytopenia described as asymptomatic. At his arrival, the patient presented slight disorientation in time and space, meanwhile the rest of the neurological exam appeared to be without findings. Clinical features such as fever, jaundice, hemorrhage, renal dysfunction and paresthesia were not found. Complete blood count reported macrocytic anaemia (hemoglobin 6.32 gr/dL), medium corpuscular volume (MCV) 115 fL, hematocrit 18.5%, white blood cells count 3.470/mm3 and platelet count 84.000/mm3 (Table 1). Blood smear showed schistocytes, dacrocytes, and stomatocytes, and negative direct Coombs test. Lactate dehydrogenase was high (4194 IU/L, plasmatic values between 150-350). Total

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bilirubin was 2.54 mg/dl, 55% indirect reacting*, and serum creatinine was normal (Table 1). ADAMTS13 activity and the presence of inhibitors were searched. The patient was transferred to an intensive care unit for urgent PEX, performing three sessions, and after second session of PEX, we realized lacking bone marrow compensatory response with low reticulocyte count (1.6%), persistent thrombocytopenia, and lower than expected drop in LDH levels (Figure 1), making megaloblastic anaemia confirmed by low plasmatic levels of cobalamin (140 pg/mL, NV 187 pg/mL – 883 pg/mL) (Table 1), suspecting Pseudo-TMA and began cobalamin supplementation.

IV. INVESTIGATIONS

Table 1: Laboratory Analysis and Follow-up Tests

Variable	Reference Range	Results on ER admission and IMD*	Results after PEX and Before Vitamin B12**	Outcome results (7 days // 30 days after first dose of Vitamin B12**)
WBC, x10³/µL	4.4 – 11.30	3.47	2.93	7.70 // 5.91
Neutrophils, %	40 – 75	57.02	59.20	71.76 // 60.95
Lymphocytes, %	25 – 40	31.32	31.68	12.33 // 25.93
Monocytes, %	2 – 8	6.01	6.29	9.30 // 7.59
Band neutrophils, %	0 – 5	0	0	0
Metamyelocytes, %	0	0	0	0
Promyelocytes, %	0	0	0	0
Myelocytes, %	0	0	0	0
Eosinophils, %	2 – 4	4.51	1.70	4.66 // 3.70
Basophils, %	0 – 1	1.12	1.12	1.194 // 1.82
Hemoglobin, g/dL	13 – 17.5	6.32	7.57	9.82 // 13.82
Hematocrit, %	40 – 52	18.51	21.34	30.48 // 42.59
Reticulocyte count, %	0.5 – 1.5		1.6	9 // 1.4
Platelet count, x10³/µL	140-400	84	58	146 // 176
MCV, fL	80 – 96	115	96	99 // 87
Total Bilirubin, mg/dL	0,2 – 1,2	2.54	2.68	0.96 // 0.3
Indirect Bilirubin, mg/dL	0 – 1,0	1.40	1.9	0.5 // 0.2
LDH, UI/L	125 – 243	4,194	972	372 // 151

ESR, mm/h	0-20	1		
Crea, mg/dL	0.72 – 1.25	0.90	0.7	0.7
Blood smear:	-	Anisocytosis, Macrocytosis, Schistocytes, Dacrocytes, Stomatocytes	-	Anisochromia ***
Myelogram				Hypercellularity, erythroid hyperplasia, scarce blasts, dysplasia of the three blood cell lineages. (•)
ADAMPTS 13 Activity, %	41 – 180	92		
Presence of ADAMPTS 13 inhibitors	No inhibitors present			
Upper GI endoscopy	Atrophic pangastritis, intestinal metaplasia. Urease test: negative.			

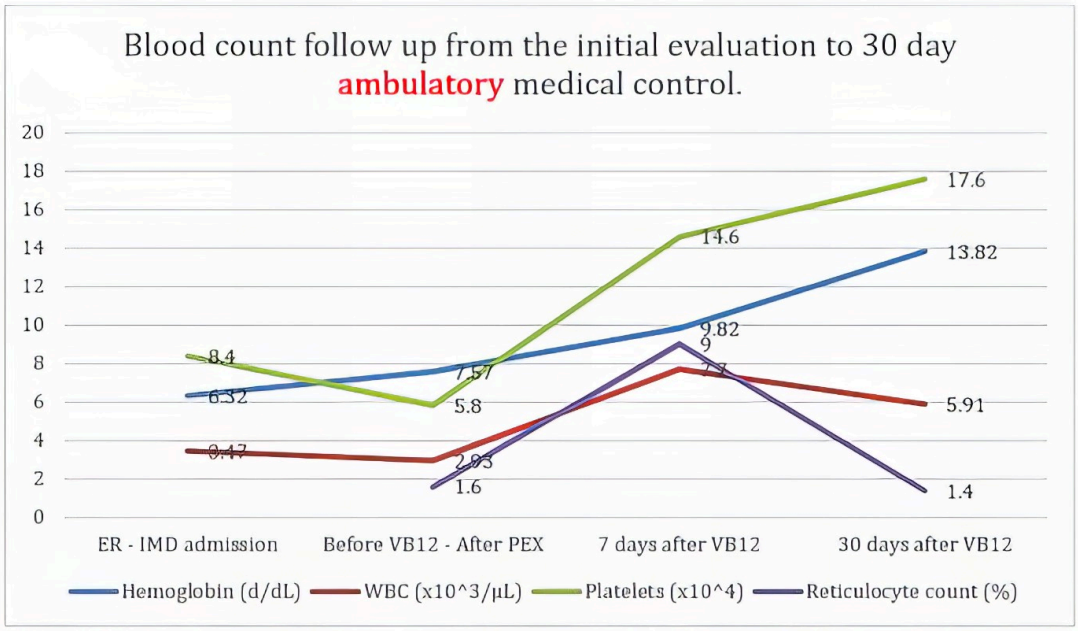
WBC: white blood cell count, MCV: Medium Corpuscular Volume, AST: Aspartate transaminase, ALT: Alanine transaminase. *AP:* Alkaline phosphatase. Crea: serum creatinine. ESR: Erythrocyte sedimentation rate. ER: Emergency room, IMD: Internal Medicine Department, PEX: Plasma Exchange. GI: Gastrointestinal.

(*): Initial laboratory findings.

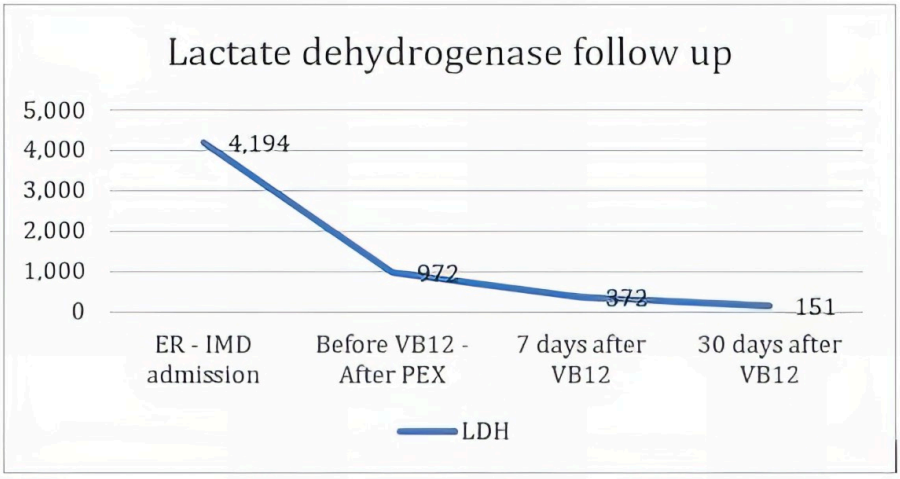
(**): After initiating Vitamin B Complex administration.

(***): Blood smear after one week of treatment with Vitamin B Complex didn't inform any abnormalities in the red blood cells' or the platelets' morphology.

(•): Myelogram performed one week after Cobalamin supplement.



WBC: white blood cell count., ER: Emergency room, IMD: Internal Medicine Department, PEX: Plasma Exchange. VB12: Vitamin B12



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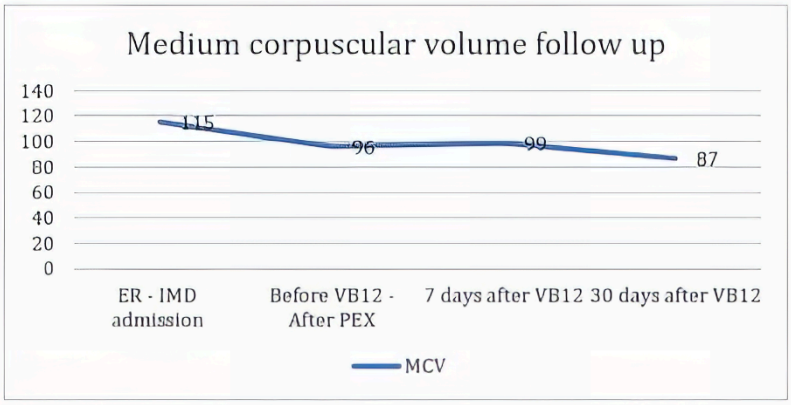

MCV: Medium corpuscular volume, ER: Emergency room, IMD: Internal Medicine Department, PEX: Plasma Exchange. VB12: Vitamin B12

Figure 1: Laboratory Tests Follow-up

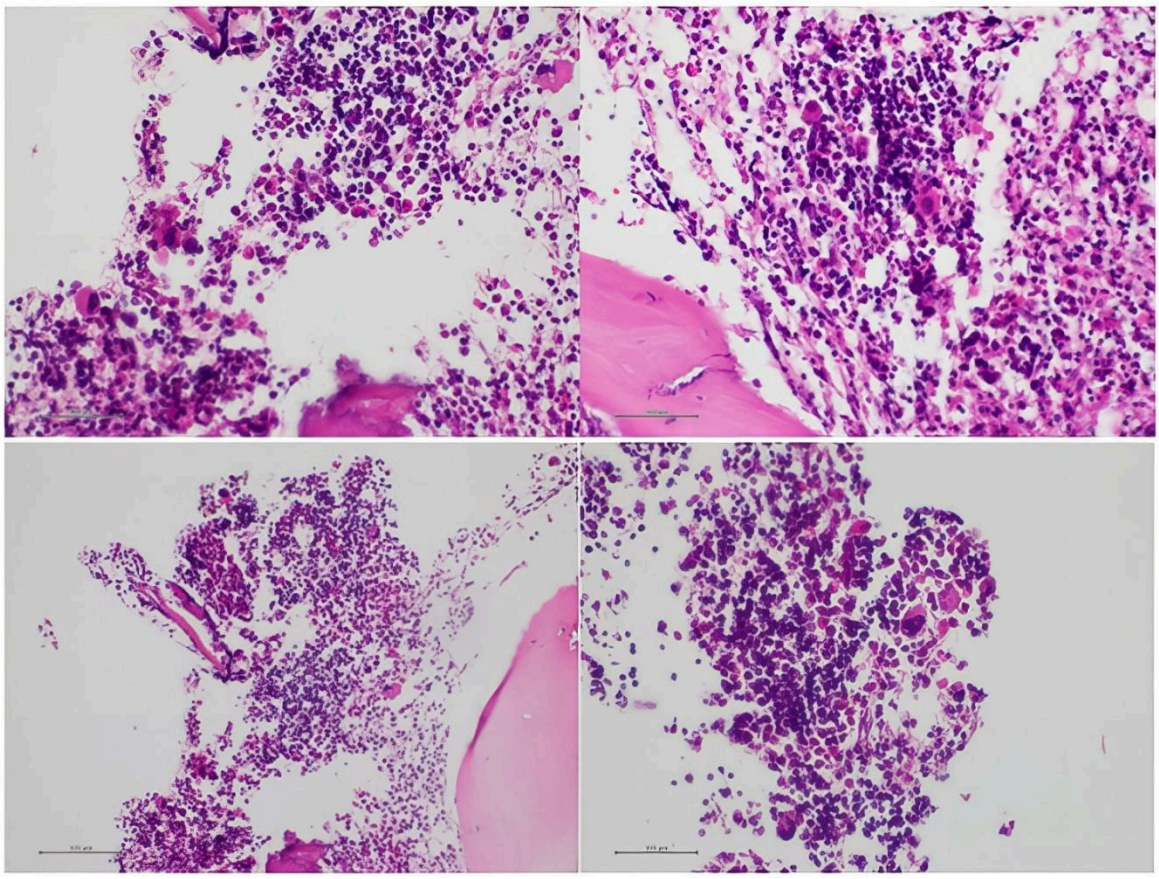

Figure 2: Bone Marrow Biopsy

Bone marrow biopsy seen by optical microscopy, showing diffuse hyperplasia, megaloblasts and some scarce elements of myelodysplastic changes.

V. DIFFERENTIAL DIAGNOSIS

Pseudo-TMA due to cobalamin deficiency, in contrast to TTP, should be suspected when there is a deficient medullary response after acute hemolysis, verified by a low reticulocyte count and low intramedullary cell counts, without renal involvement [1,2,3,4,7]. In TTP, there is a high reticulocyte count since it affects a normal bone marrow [5] and diagnoses could be helped by the PLASMIC score when it is over five points (platelets count less than 30.000, hemolysis characterized by indirect bilirubin over 2 mg/dl or undetectable haptoglobin, plus no active cancer, and no history of stem cell transplant, INR less than 1.5, MCV less than 90fL and creatinine below 2 mg/dl, one point each other maximum seven points). However, this score is not definitive for ruling out, since our patient scored five points in PLASMIC diagnostic criteria except platelet count over 30.000 and MCV over 90fL. Moreover, other features have been described to suggest Pseudo-TMA, such as higher lactate dehydrogenase levels with slow reversion after PEX, higher mean platelet counts, and lower mean neutrophil count [3,4,8,9,10]. Going deeper in differential diagnostic workup, the finding of elevated homocysteine, methylmalonic acid, presence of hyper segmented neutrophils and megaloblasts in the peripheral blood smears are also useful to guide the diagnosis of cobalamin deficiency [1].

In addition, bone marrow study (myelogram and bone biopsy) may find 3 series dysplasia, encompassing any myelodysplastic syndrome as another differential diagnosis of cobalamin deficiency [1].

VI. TREATMENT

We performed three PEX sessions since we suspected TTP diagnosis, but after finding low medium-sized response with a reticulocyte index of 1.6 percent and low levels of cobalamin, procedure was withdrawn and it was decided to use intramuscular vitamin B complex (10.000 units daily for three doses), with excellent response. One week after Vitamin B12 supplementation, there was an impressive improvement in mental symptoms and laboratory tests, both in blood (Table 1, follow up tests) and bone marrow samples (myelogram and bone biopsy). The diagnostic study was negative for TTP, and the upper gastrointestinal endoscopy was consistent with pernicious anaemia (Table 1).

VII. OUTCOME AND FOLLOW-UP

The patient underwent a rapid, clinically significant improvement in his neurological condition and laboratory findings. Thus, one week after the initiation of vitamin B complex, a reticulocyte peak was evident. Afterwards, within two weeks of hospitalization and ten days of cobalamin supplementation, the patient was discharged without any neurological symptoms, mild normocytic anemia, and normalization of the other blood cell counts, with the indication of prolonged treatment with vitamin B12. Two weeks after discharge, with an almost normal blood count, ADAMTS 13 activity resulted normal (a sample taken before first PEX session), reflecting the absence of metalloprotease inhibitors. In the current context of contingency due to SARS-CoV2, when this case happened, a most comprehensive study of probable pernicious anaemia could not be performed, and the patient withdrew follow-up before pandemic isolation was stopped.

VIII. DISCUSSION

One common cause of cobalamin deficiency is pernicious anaemia, an autoimmune disease with plasmatic autoantibodies against the Intrinsic Factor [1,2]. In our case, the gastric tissue biopsy result was consistent with pernicious anemia, but the antibodies could not be studied.

This cobalamin deficiency presentation, with clinical and laboratory findings consistent with TTP (neurological involvement, suggestive findings of MAHA encompassing anaemia, schistocytes in peripheral blood, thrombocytopenia, high levels of lactate dehydrogenase and indirect-reacting bilirubin) [6], is called Pseudo Thrombotic Microangiopathy (Pseudo TMA) [3,4,7,8,9,10]. Some case reports have described similar cases, postulating that laboratory findings were due to ineffective erythropoiesis. Other authors think there is a rise in homocysteine's blood levels, provoking endothelial dysfunction, fragmentation, and destruction of erythrocytes, the reason for appearing schistocytes in the blood smear [2]. The LDH levels appear to be higher in Pseudo TMA than in TTP, because of peripheral and intramedullary destruction of red blood cells; the presence of lower neutrophil mean count and less severe thrombocytopenia should help in differential diagnostic workup too [3,4, 8,9,10]. Another feature that guides us to cobalamin deficiency is the presence of lower reticulocyte count in Pseudo-TMA due to bone marrow failure, in contrast to being always elevated in TTP [1,4,5,7]. Moreover, elevated homocysteine and methylmalonic acid levels, hyper segmented neutrophils, and megaloblasts in peripheral blood smears in absence of acute kidney injury in Pseudo TMA, could be crucial for differentiation from TTP [1,5]. In addition, the response to cobalamin supplementation also suggested the etiology of hemolytic anemia due to the deep specific vitamin deficiency.

Pathophysiology of TTP consists in a quantitative or functional decrease of the protease ADAMTS13 on the endothelial surface, whose task is cleaving von Willebrand factor (vWf) from a macromolecule with a high capacity to recruit and activate platelets, into lower molecular weight segments with less activity [5]. Consequently, a decrease in ADAMTS13 activity promotes platelets activation and thrombus formation through every organ microcirculation [5].

Whereas, in our case, the correct diagnosis was made after significant medullary response after Vitamin B12 supplementation, meanwhile some elements of myelodysplastic syndromes were

shown in the biopsy, but this data was not considered of importance because the fact that all cellular series responded to Vitamin B12 administration, including an early reticulocyte count peak.

Unlike TTP, a hematologic emergency that implies the urgent need of PEX, the Pseudo TMA does not need that therapy [1,3,4,5]. The similarity of both clinical and laboratory pictures made PEX an initially appropriate indication, because the PLASMIC score had five points with only platelet count 84.000 and MCV over 90fL as negative findings [7].

The differential diagnosis between pseudo-TMA and TTP could be very subtle and requires a quick and profound analysis for correct diagnosis. Our opinion is that it is of utmost importance for internists to know the wide variety of presentations of cobalamin deficiency, since it is a reversible cause of bone marrow failure and misdiagnosis may lead to unnecessary costly and harmful procedures.

IX. LEARNING POINTS/TAKE HOME MESSAGES

Pseudo TMA and TTP are very similar in their clinical features.

TTP is a hematologic emergency that needs a quick PEX decision, whereas Pseudo TMA does not.

The presence of schistocytes in blood smear does not differentiate Pseudo TMA and TTP.

Clues to think in Pseudo TMA are a medullary response to hemolysis, finding low levels of reticulocytes and serum Vitamin B12, and normal levels of ADAMTS-13 activity without inhibitors.

X. INVESTIGATIONS

WBC: white blood cell count,

MCV: Medium Corpuscular Volume,

AST: Aspartate transaminase,

ALT: Alanine transaminase.

AP: Alkaline phosphatase.

Crea: serum creatinine.

ESR: Erythrocyte sedimentation rate.

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Dynamics of Frontal Collisions between Vehicles and Associated Trauma: A Literature Review

Cláudio de Souza Fernandes Júnior, Wellber Drayton Braga Galdino, Matheus de Araújo Rego, Heitor Alves Duarte, Pedro Pinper de Sousa & Maria Clara Batista de Oliveira Medeiros

Federal University of Rio Grande do Norte

ABSTRACT

Background: Traffic accident-related traumas are the leading cause of mortality among adolescents and young adults aged 15 to 29 years. Furthermore, they represent a considerable financial burden on public finances, with estimated costs of approximately 3% of the annual GDP, impacting sectors such as healthcare, infrastructure, and productivity. Accidents commonly result in polytrauma, and various criteria have been established to assess injury severity in frontal vehicle collisions. Therefore, this study aims to conduct a literature review to investigate the main patterns of injuries observed in frontal vehicle collisions over the past five years.

Methodology: This is a literature review conducted between November and December 2024, utilizing the MEDLINE database. The search employed the keyword "frontal car crashes" and was restricted to studies published within the last five years. The initial search yielded 102 articles, and after screening, using inclusion criteria such as reporting injuries from frontal vehicle collisions with human models or real-life cases, other literature reviews were excluded. A total of 8 articles were selected.

Keywords: multiple trauma, Accidents, emergency medicine.

Classification: NLM Code: WO700, WA275, WA290

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Author α σ ρ ↀ ¥: Medical Student at the Multicampi School of Medical Sciences of the Federal University of Rio Grande do Norte.

χ: Professor of the Medical Course at the Multicampi School of Medical Sciences of the Federal University of Rio Grande do Norte.

I. INTRODUCTION

Traffic accident-related traumas are the leading cause of mortality among adolescents and young adults aged 15 to 29 years. Moreover, they represent a significant financial burden on public finances, with estimated costs of approximately 3% of the annual GDP, impacting sectors such as healthcare, infrastructure, and productivity [1]. In developed countries, such as the United States, traffic accidents began to be recognized as a serious problem throughout the 20th century due to the rapid increase in the number of automobiles. In developing countries, such as Brazil, the social significance of this issue emerged in the 1970s, partly due to the growing reliance on motor vehicles for urban mobility and goods transportation, exacerbated by the lack of alternatives such as railway transportation [2].

A car accident encompasses multiple factors, such as human error, vehicle conditions, and the physical and social environment surrounding the incident [3]. The human factor is the most significant, responsible for up to 90% of traffic accidents. In this regard, one of the aspects studied is the driver's behavior while driving, particularly overconfidence and engaging in activities during driving that may distract them and significantly impair their ability to operate a vehicle [4], such as reaching for objects, adjusting the radio, eating, drinking, and using electronic devices like cell phones, GPS, and tablets, among others. Engaging in these activities causes the driver to divert their attention, impairing their ability to react promptly and avoid a collision [5].

Still within this context, accidents commonly result in polytrauma, and several criteria have been established to assess injury severity in

frontal collisions. Among the parameters used to evaluate vehicle occupant responses to impact are acceleration, force, and torque, which are applied in biomechanical studies [6]. Different criteria have been proposed for various body regions to assess the severity of injuries in car accidents, such as the head injury criterion, which is based on the acceleration of the head during the collision [7].

In this context, given the growing importance of the topic, this article aims to conduct a literature review to identify and analyze the main patterns of injuries in frontal vehicle collisions. Through the analysis of recent studies and data from various research efforts, the goal is to understand the characteristics and severity of the most common injuries in these situations, as well as to evaluate factors contributing to the intensity of impact and the human body's response.

II. METHODOLOGY

This is a literature review conducted between November and December 2024, utilizing the MEDLINE database. The search used the keyword *"frontal car crashes"* and was restricted to studies published within the last five years. The initial search yielded 102 articles. After screening, which used the following inclusion criteria: studies that reported only the outcomes of frontal collisions betweenvehicles, whether involving similar models or real-case scenarios, literature review studies were excluded. A total of 8 articles were selected.

The stages of this research were organized as follows: first, the appropriate descriptors were determined; then, in a sequential manner, the search strategy was developed, the databases were selected, the most relevant titles were chosen, and a complete reading of the texts was performed. Finally, these steps culminated in the preparation of the text.

Due to the use of secondary data from public domain sources, it was not necessary to submit the project to a Research Ethics Committee.

III. RESULTS

Table 1 presents the research results, organizing the studies according to the year of publication and their objectives. This structure was chosen for its ability to provide a comparative overview of the selected studies.

Table 1: Studies Obtained from A Literature Review on the Medline Platform, Categorized by Author, Year, Methodology and Results

Autor	Year	Methodology	Results
Khojastepour *et al*	2024	The study evaluated 91 patients with frontal sinus fractures treated at Rajaee Hospital in Shiraz between 2014 and 2019, all victims of trauma	The prevalence of frontal sinus fractures was higher among car accident victims. Combined fractures of the anterior and posterior tables were more commonly observed than isolated involvement of either the anterior or posterior table. Most frontal sinus fractures were treated conservatively without surgical intervention.
Ranmal *et al*	2024	German weighted data from 1999–2021 analyzed risk curves to predict rib and sternum fractures in automobile frontal collisions	The analysis revealed an increased risk of rib and sternum fractures in the population over 65 years old compared to individuals aged 18–65 years. Females were at a higher risk of these injuries compared to males. Sternum fractures frequently occur in isolation.

Kuwuhara *et al*	2024	The National Automotive Sampling System/Crashworthiness Data System was used to analyze maternal history, collision characteristics, outcomes, and the scores from the Abbreviated Injury Scale (AIS).The scale scores injuries in various body segments according to severity. The score ranges from 1 to 6 points, with higher scores indicating greater severity.	The results showed comparable injury severity between pregnant and non-pregnant women concerning the outcomes of abdominal injuries. Adverse outcomes for the fetus were associated with the severity of the abdominal injury. Comparison of driver seat use versus front passenger seat use by pregnant women showed no significant difference in the rate of AIS 2+ injuries or in maternal and fetal outcomes.
Ellahi *et al*	2023	Initially, a model consisting of a human body and a car was used, with muscular function activated in the lower extremity of the human model. In a second step, a deceleration pulse with a peak of 186 m/s^2 was applied to the car to simulate a frontal collision. Based on this, joint analyses were conducted to observe the responses of the lower limbs to collision forces.	This study demonstrated that the risk of femoral injury was reduced with the useof knee pads and foot cushions; however, there was a simultaneous increase in the risk of tibial injuries. The results indicated that the maximum load on the left and right legs during impact was 1.29 and 1.22 kN, respectively. Meanwhile, the maximum moment was 28.82 and 52.17 Nm, respectively. The maximum stress in the lower extremity was 87.35 MPa, and the maximum tibia index was 0.230.
Joodaki *et al*	2020	A retrospective cohort study was conducted, analyzing 13,470 cases of adult occupants with varying BMI values involved in frontal collisions. The selected data were obtained from the US National Automotive Sampling System Crashworthiness Data System.	It was observed that occupants with obesity had a higher risk of injuries to the upper extremities (4.79% vs. 2.92%), lower extremities (8.37% vs. 3.23%), and spinal column (1.53% vs. 1.09%) compared to other occupants. Talus fractures were the most common injury among the obese population. The variation in injuries based on BMI is related to the interaction between the individual, the seatbelt, and the interior of the vehicle.
Tang *et al*	2019	The study conducted parametric simulations using validated vehicle driver compartment models, a restraint system model, and a medium-sized male crash test dummy model. The risk factors considered in the study included occupant seating posture, collision pulse, vehicle inclination angle, seat design, anchorage pretensioner, dynamic locking tongue, and shoulder belt load limiter.	The results demonstrated that the risk of occupant submersion in vehicles was reduced in newer vehicle models, with an increase in lumbar injuries, indicating a direct conflict between submersion and lumbar spine fractures. The seat structure was the most significant factor in determining lumbar spine force. The severity of the collision pulse, the time at which the peak deceleration was reached, and the vehicle's tilt angle were also crucial. An increased vehicle tilt angle led to higher force on the lumbar spine but reduced force on other body regions. The initial collision pulse was more strongly associated with lumbar spine damage than later pulses.
Jermakian *et al*	2019	The methodology used was a review of case series involving rear seat occupants wearing seatbelts who were severely	In the results, 36 patients were selected who met the AIS 3 criteria, along with 81 fatalities identified in the FARS

		injured or killed in frontal collisions. Accidents were identified using the National Automotive Sampling System Crashworthiness Data System (NASS-CDS) from 2004 to 2015 and included all eligible occupants with at least one injury rated as Abbreviated Injury Scale (AIS) 3 or higher. Fatal accidents were identified in the Fatality Analysis Reporting System (FARS) for 2014-2015, and local law enforcement jurisdictions were then contacted for complete accident records.	database. Initial observations revealed that more than half of the injured and deceased rear seat occupants exhibited greater injury severity compared to front seat occupants involved in the same collision. This study observed a discrepancy in the effectiveness of rear seat belt protection compared to that of front seatbelts. Thoracic injuries and traumatic brain injuries were the main causes of high morbidity and mortality among these victims.

IV. DISCUSSION

Injuries resulting from the mechanism of frontal collisions in automobile accidents are associated with high rates of morbidity and mortality in the adult population. The main injuries from these collisions occur due to the interaction of the victim with the automobile. Facial, aortic, and extremity injuries are the most commonly reported in frontal vehicle collisions. Trauma related to the steering wheel is directly linked to thoracic structures, such as rib fractures, sternum fractures, myocardial contusion, aortic injuries, and pulmonary injuries. The lower extremities are directly impacted by forces opposing the victim's ejection, resulting from the interaction of the pelvis and lower limbs with the vehicle's dashboard [8].

The epidemiological analysis conducted by Ranmal *et al* [9] collected weighted German data from 1999 to 2021, evaluating risk curves to predict rib and sternum fractures in frontal automobile collisions. The review revealed that elderly individuals and women have a significantly higher risk of thoracic injuries in accidents with this collision mechanism. Rib and sternum fractures were more commonly associated with the population over 65 years old compared to individuals aged 18-64 years. The data showed that women have a higher risk of sustaining more severe rib injuries and isolated sternum injuries compared to men.

Khojastepour *et al* [10] assessed the prevalence of frontal sinus injuries in 91 trauma patients treated at Rajaee Hospital in Shiraz between 2014 and 2019. The analysis revealed a higher prevalence of these injuries among victims of automobile accidents caused by frontal collision mechanisms. Frontal sinus injuries occurred frequently (74.7%) in conjunction with other facial injuries. Furthermore, combined fractures of the anterior and posterior table were more commonly observed than isolated involvement of either table.

Both Ranmal and Khojastepour [9,10] demonstrated that there is a pattern of injuries associated with facial and thoracic injuries that correlate with the mechanism involved in automobile accidents. A frontal collision promotes the projection of the individual against the vehicle's structure, significantly impacting facial and thoracic regions. The injuries are varied and exhibit a wide spectrum of severity, ranging from fatal to those with a good prognosis without the need for immediate medical intervention [8].

Ellahi *et al* [11] evaluated patterns of injuries in frontal vehicle crash tests against fixed barriers, aiming to analyze trauma patterns in biofidelic human body models. The study quantified the pressure required for structural injury occurrence. The megapascal (MPa) is a unit of pressure measurement in the International System of Units (SI) that represents force applied per unit area, equivalent to 1 million pascals (Pa). A pascal is defined as 1 newton per square meter (N/m^2). Rib fractures (5-7) were observed at stresses of 120 MPa in the left lateral vertebrosternal region. In the lower extremity, ligament ruptures were identified at 70.80 MPa, while fractures in the tibia and femur occurred at 236 MPa. Cranial stresses were limited to 11 MPa, suggesting the possibility of concussions rather than fractures. Therefore, traumatic injuries

highlight a significant relationship between the individual and the vehicle, with the main complications arising from impacts causing considerable deceleration of the vehicle-victim system [12].

Tang *et al.* [13] demonstrated through simulations that the incidence of submersion in victims of frontal collisions is reduced in newer vehicles. However, they observed a higher risk of lumbar spine fractures associated with these collisions. The findings indicated that factors reducing the risk of submersion simultaneously increased the forces affecting the victim's lumbar spine. From a biomechanical perspective, the primary mechanism of lumbar spine fracture is high-energy axial compression, with or without flexion transferred to the region [14, 15, 16, 17, 18, 19]. The vehicle's angle of inclination was identified as the most influential parameter in determining the lumbar spine injury pattern, with increased angulation raising the risk of fractures. On average, an erect posture applies less force to the lumbar spine compared to a reclined posture, resulting in a reduced risk of lumbar fractures in frontal vehicle collisions [13]

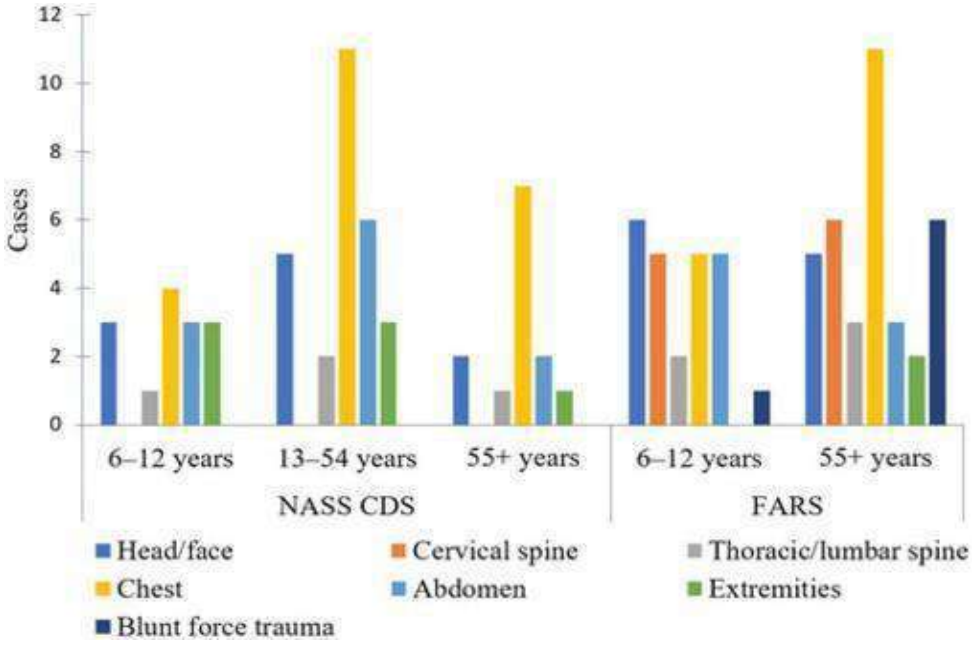
Joodaki *et al.* [20], in a retrospective cohort study, analyzed 13,470 frontal collision cases from the US National Automotive Sampling System-Crashworthiness Data System. The aim was to evaluate the influence of body mass index (BMI) on injury risks across different body regions. Results revealed an increased incidence of injuries in obese individuals compared to non-obese individuals: 4.79% versus 2.92% in the upper extremities; 8.37% versus 3.23% in the lower extremities; and 1.53% versus 1.09% in the spinal column. Among lower extremity injuries, talus fractures were the most common. These differences in injury patterns are linked to the interaction between overweight individuals, seatbelt use, and the vehicle's interior, which affect the forces during collision impacts.

Kuwahara et al. [21] observed that non-pregnant women sustained more moderate to severe injuries, with higher scores on the AIS scale, particularly in head injuries, compared to pregnant women. No evidence was found indicating an increased risk of abdominal injuries in pregnant women, regardless of abdominal protrusion or gestational week. Other non-pregnancy-related factors appeared to be more closely associated with abdominal injuries, showing similar numbers between pregnant and non-pregnant women. Regarding fetal risk, fetal harm was more closely linked to the severity of the maternal abdominal injury, with more severe cases being more detrimental to the fetus.

Additionally, changing the pregnant woman's seat position did not demonstrate any significant impact on the risk to the maternal-fetal dyad during frontal automobile collisions.

Jermakian *et al.* [22], analyzing data from the National Automotive Sampling System Crashworthiness Data System (NASS-CDS, 2004-2015) and the Fatality Analysis Reporting System (FARS, 2014-2015), demonstrated greater severity of injuries among rear-seat occupants involved in automobile crashes compared to front-seat occupants. In frontal collisions, after adjusting for variables such as occupant age, impact direction, and other factors, no increased risk of death was identified for rear-seat occupants compared to those in the front seat. However, frontal impacts were responsible for a higher proportion (34%) of fatalities among rear-seat occupants who were restrained.

The affected body regions varied according to the lethality of the event and the victims' age (Figure 1). Among survivors, thoracic injuries were the most prevalent, followed by facial and head injuries, regardless of age. In fatal cases, differences in injury patterns were observed based on age groups. For victims over 55 years old, thoracic injuries were the most common. In contrast, among children aged 6 to 12 years, head and facial injuries were more frequent [22].



Source: Jermakian et al

Figure 1: Injured body regions of vehicle occupants stratified by age and data source. FARS counts were limited to cases with documented injuries (n = 17 for ages 6–12 years and n = 20 for ages 55+ years)

Jermakian *et al.* also investigated collision and restraint factors related to injuries and deaths among rear seat occupants during frontal impacts in newer vehicle models. The primary factors responsible for injuries included seatbelt loading and impact with the vehicle's interior. In fatal cases, the most relevant factors were seatbelt loading and the severity of the collision, considered unsurvivable. Chest compression caused by the seat belt resulted in different injury patterns depending on the victim's biophysical profile and age. Children experienced a higher incidence of blunt pulmonary injuries, while adults showed a greater frequency of rib fractures, cardiac injuries, and vascular injuries (Table 2).

Table 2: Factors Associated with Injuries and Fatalities in Rear-Seat Occupants During Frontal Impacts in Newer Vehicle Models

	N	Possible Contributing Factors To Injury (Number Of Cases)
6-12 years old		
Head/face	12	Catastrophic intrusion/unsurvivable collision (6; 4 due to severe collision, 2 due to slight overlap) Non-catastrophic intrusion (1) Associated cervical injury (3) Insufficient information (2)
Chest	7	Should belt loading (4) Catastrophic intrusion/unsurvivable collision (2) Insufficient information (1)
Abdomen	5	Seat belt only, submersion (1) Loading of the neck and shoulder seat belt on dry organs (3) Insufficient information (1)
55+ years old		
Head/face	6	Seat belt only (1) Catastrophic intrusion/unsurvivable collision (1) Intrusion requiring occupant extraction (1) Associated cervical injury (1) Insufficient information (1)
Chest	11	Shoulder belt loading (7) Obesity (2) Abdominal belt only (1) Insufficient information (3)
Abdomen	3	Shoulder belt load on the liver/spleen (3) Non-catastrophic intrusion (1)

Source: Adapted from Jermakian et al, 2019

The prevalence of traumatic injuries in frontal collisions is heterogeneous and influenced by various factors, particularly the interaction between the individual and the automobile.

Among the variables related to the victims, body mass index (BMI), seating position in the vehicle, and the collision's intensity are the most significant factors described in the literature [Concerning the automobile, the restraining force of the seatbelt and the impact with the vehicle's interior represent the primary interactions during the collision event [22].

V. CONCLUSIONS

The analysis of the 8 selected articles provided relevant information regarding the patterns of trauma in victims of automobile accidents with frontal collision mechanisms, offering insight into the factors influencing the severity of injuries in these accidents.

The analyzed data demonstrate that the patterns of trauma in frontal collisions exhibit wide variability and are influenced by multiple factors related both to the individual characteristics of the victim and the characteristics of the vehicle. Variables such as BMI, position in the vehicle, and the collision's intensity have a direct relationship with the likelihood of injury occurrence and the severity of the trauma. Furthermore, vehicle-related factors, such as the restraining force of the seatbelt and impact with the interior of the vehicle, play a determining role

in the dynamics and severity of injuries, as evidenced by the studies analyzed in the literature review and compared with current medical literature [13, 20, 22]. These findings underscore the importance of addressing the biomechanics of injuries from a multidimensional perspective to better understand the complexity of trauma in collisions.

The findings also indicate differentiated patterns of injuries in children and adults, highlighting the importance of the biophysical profile during impact. These differences reflect not only physical characteristics but also the specific mechanisms of impact dynamics and individual biomechanical responses. Therefore, analyzing these patterns should be considered in prevention strategies and the development of safety devices tailored to different age groups.

Furthermore, the data suggest that the prevention of injuries in frontal collisions should involve both vehicle adaptation and awareness of individual risk factors. Strategies such as improving restraint systems, adjusting seat belt mechanisms, and advancing automobile design can significantly reduce the impact of collision-associated factors. Thus, through multidisciplinary approaches involving engineering, medicine, and public traffic policies, it is possible to implement measures that enhance occupant safety and decrease the incidence and severity of injuries resulting from automobile accidents.

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Glaucoma Secondary to Uveitis Due to Posner Schlossman Syndrome

MD Paulo Henrique Nesi de Campos

ABSTRACT

Considering the clinical relevance of secondary glaucoma due to uveitis in posner-schlossman syndrome (PSS), this study aims to evaluate the natural history of this condition in a patient. To that end, we present the case of a 41-year-old man who experienced hyperemia, mild eye discomfort and decrease in visual acuity in the left eye. The initial ophthalmological examination revealed an intraocular pressure (IOP) of 30 mmhg in the left eye and 19 mmhg in the right, with gonioscopy showing an open angle and trabecular pigmentation. The patient was treated with topical corticosteroids, resulting in normalization of IOP. During follow-up, the patient experienced recurrent episodes of anterior uveitis with IOP ranging from 22 mmhg to 28 mmhg until april 2024. OCT examinations showed thinning of the nerve fiber layer, while visual fields remained normal. Thus, it is observed that early diagnosis and treatment are crucial for the effective management of secondary glaucoma due to uveitis, contributing to the preservation of visual function. It is concluded that rapid intervention with topical corticosteroids is essential to prevent glaucomatous neuropathy secondary to uveitis and to maintain the patient's ocular health.

Keywords: secondary glaucoma, uveitis, posner-schlossman syndrome, intraocular pressure, topical corticosteroids.

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Keywords: secondary glaucoma, uveitis, posner-schlossman syndrome, intraocular pressure, topical corticosteroids.

I. INTRODUCTION

Posner-schlossman syndrome (PSS), also known as glaucomatocyclitic syndrome, was first described in 1948 and is characterized by recurrent episodes of mild anterior uveitis, associated with transient elevations in intraocular pressure (IOP). The episodes are typically unilateral and self-limiting, lasting from a few hours to weeks. Although its exact etiology remains unclear, recent studies suggest a possible association with infectious agents such as cytomegalovirus (CMV), herpes simplex virus (HSV), and possibly helicobacter pylori. (1) Additionally, there are investigations indicating a genetic relationship with the presence of HLA-Bw54 in Japanese patients with PSS. This association with HLA suggests a genetic basis for PSS. However, the contribution of HLA to the entire PSS spectrum is unknown. (2)

PSS predominantly affects young adults, with a higher incidence in men, but it can also occur in children and the elderly. The main clinical challenge lies in the proper control of IOP during episodes, as persistent IOP elevation can lead to secondary glaucoma and permanent damage to the optic nerve. Studies reviewing the clinical experience with the syndrome over 10 years highlight that factors such as elevated IOP and prolonged episode duration increase the risk of glaucomatous damage, emphasizing the importance of early diagnosis and appropriate IOP management to prevent long-term complications. (1)

1.1 Objectives

This study aims to report a case of posner-schlossman syndrome that progressed to secondary glaucoma, highlighting the importance of early diagnosis and proper IOP management during episodes. Specifically and measurably, it seeks to evaluate the therapeutic interventions used and their impact on IOP control, as well as discuss the possible complications associated with disease progression.

II. THEORETICAL FRAMEWORK

Posner-Schlossman syndrome was first described in 1948 as a condition characterized by recurrent, acute attacks of mild, unilateral, nongranulo-

matous, anterior uveitis accompanied by markedly elevated intraocular pressure. (1) However, there are some rare descriptions of bilateral simultaneous presentation of PSS (4).

Historically, PSS was seen as a self-limiting condition with a positive prognosis, which led to inadequate long-term follow-up and treatment, particularly regarding intraocular pressure. With advancements in research on PSS and long-term follow-up studies, it became clear that secondary glaucoma can develop in some patients. (3) Since its initial description, the cause of posner-schlossman syndrome has been widely discussed. Recently, some cases have been linked to viral infections, such as cytomegalovirus (CMV), herpes simplex (HSV), and varicella-zoster virus. Polymerase chain reaction (PCR) analyses of aqueous humor from patients with PSS revealed that 52% tested positive for CMV(1) Furthermore, recent studies have indicated that in some patients with PSS, the corneal endothelial cell density (CEC) is lower in the affected eye compared to the healthy eye, and that some of these situations are associated with CMV infections. (1) The overwhelming evidence suggests that the pathogenesis of PSS is infection of the anterior chamber, most commonly by cytomegalovirus, and clinicians should have a high index of suspicion and a low threshold for performing aqueous biopsy to detect the virus by PCR. Why glaucomatocyclitis develops in some patients and endotheliitis in others remains to be resolved and will be a focus of research in the future. (1)

On ophthalmologic examination, patients have open angles on gonioscopy and recurrent unilateral episodes of mild iritis with elevated intraocular pressure. During attacks, blurred vision and mild inflammation in the anterior chamber occur, along with small keratic precipitates. These episodes usually resolve within a few days, and IOP normalizes between attacks. PSS is more common in young individuals, making the prevention of vision loss due to elevated IOP crucial. (1) Although there is considerable evidence that PSS can result in secondary glaucoma, there is limited data on the clinical differences between patients with PSS who develop secondary glaucoma and those who experience just intermittent IOP elevations. (2)

The treatment of posner-schlossman syndrome aims to control both inflammation and elevated intraocular pressure, to prevent optic nerve damage caused by the condition (1).

Frequent attacks of high IOP represent a significant risk, as they can compromise vision, leading to progressive visual field defects. Therefore, controlling IOP is the main treatment goal, with an initial approach combining anti-inflammatory and antiglaucomatous eye drops. However, some patients do not respond to this treatment and may require glaucoma surgery to prevent visual field loss. Trabeculectomy has proven effective in some of these cases. Although surgery is traditionally not indicated for PSS, in cases of frequent recurrence, secondary glaucoma may develop, requiring surgical intervention for control (3). New surgical techniques have been performed with superior efficacy and safety, the microinvasive glaucoma surgeries (MIGs), being a safer alternative to traditional trabeculectomy. (4) However, in general, only a subset of patients with PSS who develop progressive visual field defects require glaucoma surgery. (1)

II. METHODOLOGY

This study is a clinical case report that describes the evolution of posner-schlossman syndrome in a 41-year-old male patient. The initial diagnosis was made through a complete ophthalmological exam, including intraocular pressure measurement, fundoscopy, gonioscopy, and imaging exams, such as optical coherence tomography (OCT) and perimetry. The research was conducted between 2019 and 2024, with periodic follow-up to assess the evolution of the condition and response to treatment. The patient received treatment with topical corticosteroids to control the uveitis, and when necessary, anti-glaucomatous medications were introduced to reduce IOP.

Included in this study were the follow-up records of the patient, laboratory exams, the evolution of IOP and changes in the retinal nerve fiber layer over time. Perimetry exams were also conducted

to monitor potential damage to visual field of the patient. The clinical evolution was monitored based on literature reviews and guidelines on the management of PSS and secondary glaucoma, considering evidence-based therapeutic interventions.

IV. CASE REPORT

The patient was admitted to the medical service in 2019 reporting symptoms of hyperemia, mild eye discomfort and decrease in visual acuity in the left eye for 4 days. He had a family history of a father with glaucoma who had already undergone surgery. On ophthalmological examination he presented an IOP of 19 mmhg in the right eye, IOP of 30mmhg in the left eye, mild iritis and discreet reagent mydriasis in the left eye characterizing a picture of hypertensive anterior uveitis. Fundoscopy revealed a cup/disc ratio of 0.2 in both eyes.

Considering PSS as a plausible hypothesis, treatment with steroids, antiglaucomatous eye drops was started and an etiological investigation was started. The patient did not consent to paracentesis for aqueous humor sample for virus analysis. He underwent OCT and visual field examination at the time, in both eyes, showing no significant changes. Blood serology revealed that the patient was positive for anti-CMV IgG and anti-HSV IgG antibody (table 1)

Subsequently the patient presented 7 more episodes of hypertensive uveitis in the same left eye during the 48-month follow-up, with IOP ranging from 22mmHg to 28mmHg, always treated with corticosteroid and antiglaucomatous eye drops. However, OCT exams demonstrated a progressive thinner of the nerve fiber layer of the retinal in both eyes (Figure 1, 2 and 3), more pronounced in the left eye, although the visual fields remained normal (Figure 4, 5, 6 and 7). The hypothesis of onset of primary open-angle glaucoma in the contralateral eye was risked due to the progressive thinner of the nerve fiber layer and chronic treatment was started in both eyes with frequent monitoring.

PSS appears to be initially self-limited, however, over time, it can result in chronic open-angle glaucoma and consequent permanent loss of visual field. In the case in question, the patient, in addition to developing thinning of the nerve fiber in the eye with the crises, also had thinning in the contralateral eye, indicating the onset of primary open-angle glaucoma, requiring treatment and monitoring in both eyes to prevent visual loss.

Recent studies on PSS corroborate that elevation of IOP during uveitis attacks is one of the main risk factors for the development of secondary glaucoma. Early interventions with topical corticosteroids and antiglaucoma medications have shown to be effective in controlling, preventing long-term visual complications. However, the thinner of the nerve fiber layer observed in the patient reflects the continuous risk of glaucomatous neuropathy, suggesting that close monitoring is essential to adjust interventions according to clinical evolution. (3)

Classically, eyes with presumed PSS have been treated with steroids and antiglaucoma medications. However, the disadvantages of such a practice have been emphasized recently. The repeated use of steroids may be permissive to viral replication, leading to increasingly frequent attacks and attendant glaucomatous damage. Although the optimal management of these eyes is still uncertain, topical NSAIDs theoretically may be a safer option when PCR analysis of the aqueous humor is positive for CMV. (6)

We conclude that a correct diagnosis is important in establishing effective treatment, since the fact that the patient had a hypertensive crisis in one eye did not rule out the possibility of the onset of chronic glaucoma in the other eye. Although it is difficult to establish a therapeutic standard due to the rarity of the disease, the regimen with topical hypotensive and topical NSAIDs or corticosteroids appears to be the most appropriate form of treatment. The surgical procedure is reserved for select and refractory cases. (6)

V. CONCLUSION

The clinical case discussed highlights the importance of early diagnosis and aggressive intervention in the management of

posner-schlossman syndrome, particularly to avoid progression to secondary glaucoma. Treatment with topical corticosteroids and anti-glaucoma medications was effective in normalizing IOP and preserving the patient's visual function, but the thinning of the nerve fiber layer indicates the need for rigorous follow-up and consideration of additional therapies if necessary. Early and continuous IOP management is essential to avoid permanent optic nerve damage and maintain the patient's ocular health.

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Table 1: Laboratory findings

Serum HSV IgG/IgM	+ / -
Serum CMV IgG/IgM	+ / -
Serum HTLV	-
Serum FTABs IgG/IgM	- / -
HIV screen	-
HLA-B27	-
RF Test	-
ANA Test	-

CMV Cytomegalovirus, *HSV Herpes Simplex Virus*, *HIV* human immunodeficiency virus, RF Rheumatoid Factor, ANA Antinuclear antibody

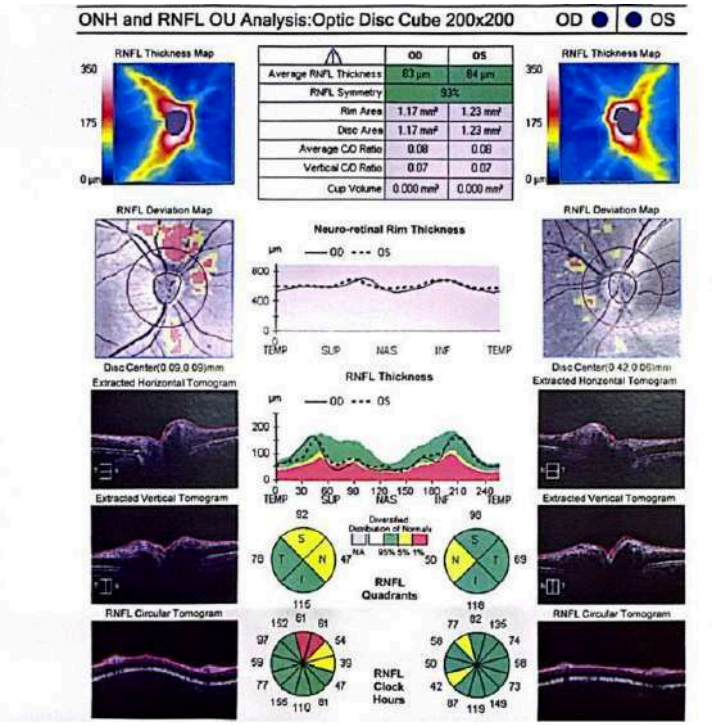

Figure 1

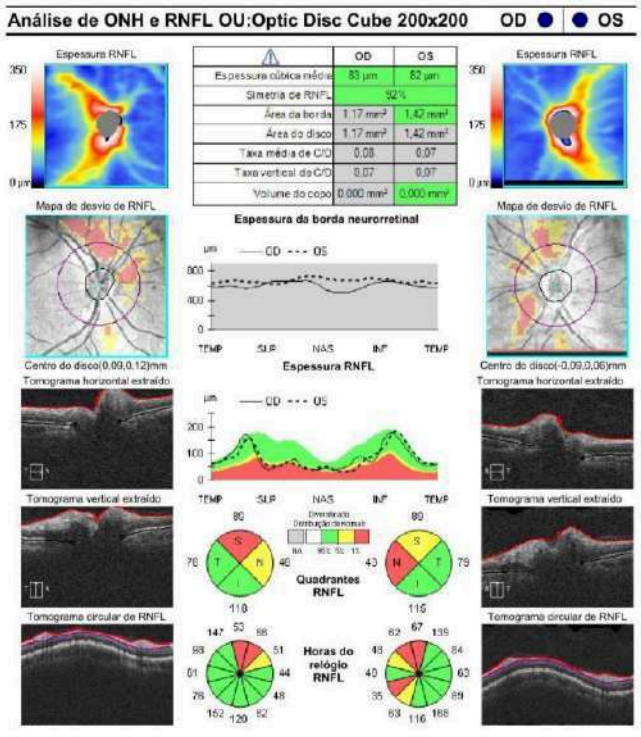

Figure 2

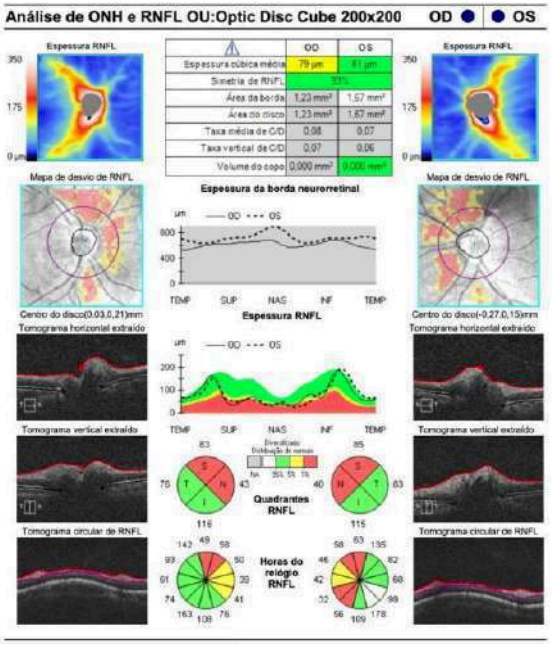

Figure 3

Evolution of nerve fiber layer thinning, Figure 1 (2019), Figure 2 (2023), Figure 3 (2024)

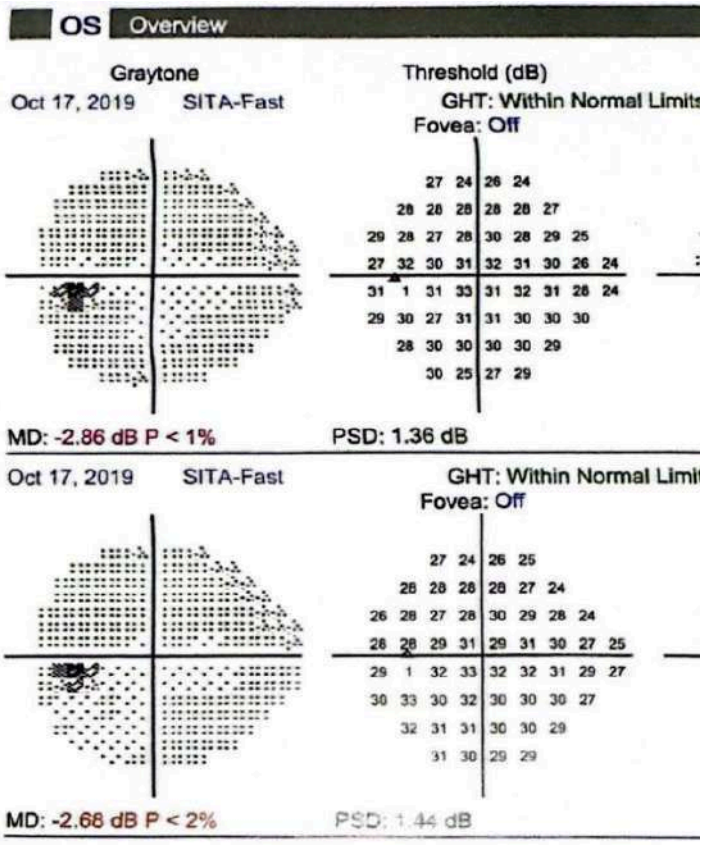

Figure 4

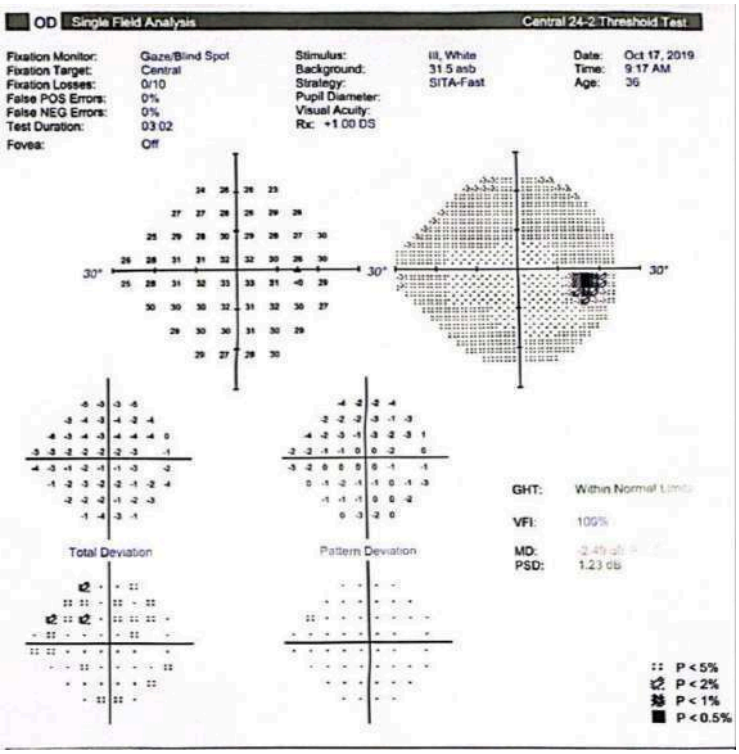

Figure 5

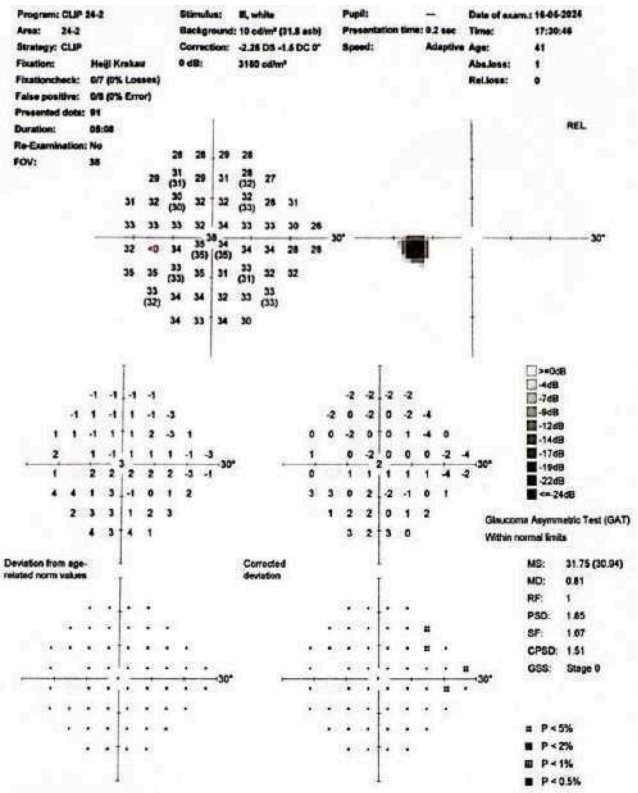

Figure 6

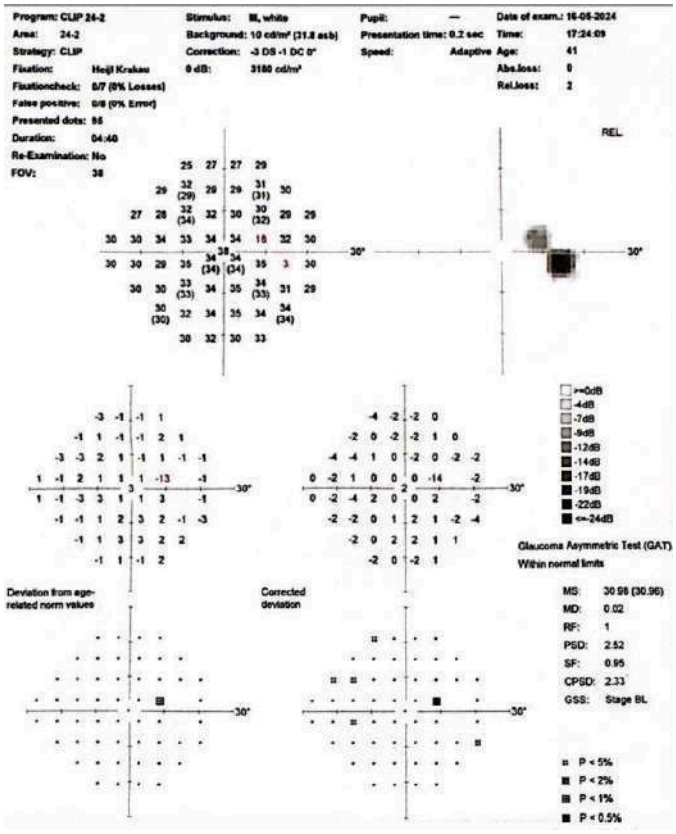

Figure 7

Evolution of the perimetry, Figure 4 and 5 (2019), Figure 6 and 7 (2024)

Invasive Meningioma of the Infratemporal Fossa Case Report and Review of the Literature

Luis Manuel Bernal Mendoza, Juan Manuel Salgado Camacho, Sandra Jocelyn Aguilar Larios & Sebastián Rescalvo Garduño

ABSTRACT

Introduction: Meningiomas are common tumors of the central nervous system, originating from the meningotheleal cells of the arachnoid. Most meningiomas are benign and develop within the skull; some may extend extracranially, an unusual behavior that poses challenges in both diagnosis and treatment.

Case report: We present the case of a 51-year-old woman with a meningioma in the right temporal and zygomatic region, which was initially asymptomatic. Imaging studies revealed an invasive lesion to the bone and soft tissues of the temporal region, including the orbit and infratemporal fossa. The patient underwent a two-stage surgery, achieving a subtotal resection of the tumor, which was reported as fibrous meningioma.

Palabras Clave: meningioma, extracraneal, fosa infratemporal, resección tumoral.

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Invasive Meningioma of the Infratemporal Fossa Case Report and Review of the Literature

Meningioma invasor de la fosa infratemporal Reporte de un caso y revisión de la bibliografía

Luis Manuel Bernal Mendoza[α], Juan Manuel Salgado Camacho[σ], Sandra Jocelyn Aguilar Larios [ρ] & Sebastián Rescalvo Garduño[Ω]

RESUMEN

Introducción: Los meningiomas son tumores frecuentes del sistema nervioso central, originados a partir de las células meningoteleales de la aracnoides. La mayoría de los meningiomas son benignos y se desarrollan dentro del cráneo, algunos pueden extenderse extracranealmente, un comportamiento inusual que implica desafíos tanto en el diagnóstico y tratamiento.

Reporte del caso: Presentamos el caso de una mujer de 51 años con un meningioma en la región temporal y cigomática derecha, que inicialmente fue asintomático. Los estudios de imagen revelaron una lesión invasiva hacia el hueso y tejidos blandos de la región temporal, incluyendo la órbita y la fosa infratemporal. La paciente fue sometida a una cirugía en dos etapas, logrando una resección subtotal del tumor, el cual fuer reportado como meningioma fibroso.

Discusión: Aunque los meningiomas extracraneales son infrecuentes, pueden surgir como una extensión extracraneal de tumores intracraneales o presentarse primariamente fuera del sistema nervioso central (SNC). Esto plantea un desafío diagnóstico considerable debido a su ubicación atípica y la falta de síntomas neurológicos iniciales, lo que puede retrasar su detección. Los meningiomas con extensión extracraneal y transósea presentan un mayor riesgo de complicaciones quirúrgicas, y se ha demostrado que abordajes quirúrgicos complejos, como craneotomías orbitocigomáticas y resecciones en múltiples etapas, son necesarios para alcanzar una resección adecuada y reducir las recurrencias.

Conclusión: La resección quirúrgica de estos tumores implica un reto debido a su extensión, lo que subraya la importancia de un enfoque terapéutico multidisciplinario.

ABSTRACT

Introduction: Meningiomas are common tumors of the central nervous system, originating from the meningotheleal cells of the arachnoid. Most meningiomas are benign and develop within the skull; some may extend extracranially, an unusual behavior that poses challenges in both diagnosis and treatment.

Case report: We present the case of a 51-year-old woman with a meningioma in the right temporal and zygomatic region, which was initially asymptomatic. Imaging studies revealed an invasive lesion to the bone and soft tissues of the temporal region, including the orbit and infratemporal fossa. The patient underwent a two-stage surgery, achieving a subtotal resection of the tumor, which was reported as fibrous meningioma.

Discussion: Although extracranial meningiomas are rare, they can arise as an extracranial extension of intracranial tumors or occur primarily outside the central nervous system (CNS). This poses a considerable diagnostic

challenge due to its atypical location and lack of initial neurological symptoms, which may delay its detection. Meningiomas with extracranial and transosseous extension have a higher risk of surgical complications, and complex surgical approaches, such as orbitozygomatic craniotomies and multistage resections, have been shown to be necessary to achieve adequate resection and reduce recurrences.

Conclusion: Surgical resection of these tumors is challenging due to their extent, underscoring the importance of a multidisciplinary therapeutic approach.

Palabras Clave: meningioma, extracraneal, fosa infratemporal, resección tumoral.

Author α σ ρ Ↄ: Departamento de Neurocirugía del Hospital Regional de Alta Especialidad Ixtapaluca, México.

I. INTRODUCCIÓN

Los meningiomas son tumores frecuentes del sistema nervioso central, originados a partir de las células de la aracnoides. Representan aproximadamente el 20-30% de todos los tumores intracraneales, en algunas bibliografías refiriéndose hasta el 53.2% de los tumores no malignos del sistema nervioso central en los Estados Unidos, y suelen afectar predominantemente a mujeres en edades medias a avanzadas [1,2]. Los meningiomas son clasificados según la OMS (Organización Mundial de la Salud) en benignos (grado 1), atípicos (grado 2) y malignos o anaplásicos (grado 3)[2].

El grado histologico lo otorgan el número de mitosis, otorgando grado 2 en caso de de 4 a 19 figuras mitóticas en 10 campos de seco fuerte asi como invasión cerebral, subtipo morfológico específico, mayor celularidad, células pequeñas con alta relación nucleo citoplasma, nucléolos prominentes, crecimiento en forma de lámina (crecimiento ininterrumpido sin patrón o en forma de lámina), focos de necrosis espontánea (no iatrogénica). Para el grado 3 se toman 20 o más figuras mitóticas en 10 campos de seco fuerte consecutivos de cada 0. 16 mm2 (al menos 2,5/mm2), franca anaplasia, mutación del promotor de TERT o deleción homocigótica de CDKN2A y/o CDKN2B[11].

Si bien la mayoría de los meningiomas son benignos y se desarrollan dentro del cráneo, algunos pueden extenderse extracranealmente, un comportamiento inusual que implica desafíos tanto en el diagnóstico como en el manejo clínico[1].

Los meningiomas en la región de la fosa infratemporal y áreas faciales son extremadamente raros, y su presentación extracraneal añade complejidad a su tratamiento. Este tipo de meningiomas puede presentarse con síntomas atípicos y vagos, como otalgia, tinnitus o incluso otitis media, lo que complica su diagnóstico diferencial, que incluye desde neoplasias benignas a malignas de tejidos blandos y óseos. Además, la afectación de estructuras como el nervio trigémino o la invasión de músculos profundos hace necesaria una planificación quirúrgica cuidadosa para minimizar el riesgo de complicaciones neurológicas y faciales[3].

Dado el carácter raro y el comportamiento invasivo de estos tumores en áreas extracraneales, el tratamiento principal consiste en la resección quirúrgica, que debe ser completa para reducir la posibilidad de recurrencia. En casos de resección parcial, se recomienda radioterapia complementaria. La identificación precisa mediante técnicas de imagen, como resonancia magnética y tomografía computarizada, junto con la confirmación histológica, es fundamental para el diagnóstico definitivo de estos meningiomas atípicos (Meningioma Infratemporal)[4].

II. REPORTE DE CASO

Presentamos el caso de una mujer de 51 años sin antecedentes médicos relevantes, quien presentó un crecimiento progresivo de volumen en la región temporal y cigomática derecha durante dos años, caracterizado por una lesion redonda, dura, y no móvil, asintomática en ese momento.

Posteriormente, la paciente desarrolló una parálisis facial periférica izquierda no relacionada con la lesión, por lo que acudió a un cirujano maxilofacial en un centro privado. Se realizó una

biopsia de la lesión temporal, con resultado histopatológico de meningioma, y fue referida a nuestra unidad.

En los estudios de imagen, en la tomografía computarizada revela una lesión iso- e hipodensa en comparación con el parénquima cerebral. La masa afectaba el polo temporal, el hueso de la fosa media derecha, el cual erosionava, los tejidos blandos de la región temporal y cigomática, la pared lateral de la órbita derecha, y se extendía hacia la fosa infratemporal. En la resonancia magnética, la lesión se mostraba isointensa en relación con el parénquima cerebral y e invadia de tejidos blandos, captando contraste de manera homogénea.

La paciente fue sometida a cirugía en dos tiempos. Inicialmente, se realizó una craneotomía orbitocigomática y resección microquirúrgica del tumor. Se encontró infiltración tumoral en el músculo temporal, hueso hiperostótico, duramadre, y el tercio externo del ala esfenoidal. En el segundo procedimiento, se reapertura la craneotomía previa y se realizó una resección dirigida hacia las fosas infratemporal y pterigopalatina derechas, observándose un tumor infiltrante en el músculo temporal, con extensión hacia estas fosas.

Tras la resección subtotal de aproximadamente el 90% del tumor, el análisis histopatológico confirmó un meningioma fibroso grado I de la OMS, con un indice de Ki67 del 5%.

III. DISCUSIÓN

Aunque los meningiomas extracraneales son infrecuentes, pueden surgir como una extensión extracraneal de tumores intracraneales o presentarse primariamente fuera del sistema nervioso central (SNC). Esto plantea un desafío diagnóstico considerable debido a su ubicación atípica y la falta de síntomas neurológicos iniciales, lo que puede retrasar su detección. Estudios previos destacan que estos meningiomas suelen manifestarse en áreas como la fosa infratemporal y las regiones paranasales, y son difíciles de diagnosticar debido a la ausencia de sintomatología evocadora[3,5,6].

La extensión hacia estructuras críticas como la fosa infratemporal y la órbita, como se observó en el caso, es un desafío debido a la proximidad a estructuras neurológicas y vasculares importantes. Esto requiere una planificación quirúrgica cuidadosa, incluyendo técnicas avanzadas de resección y, en algunos casos, enfoques multidisciplinarios. En estudios similares, se ha informado que la cirugía para meningiomas en áreas de difícil acceso a menudo implica procedimientos complejos y la colaboración de equipos especializados en base de cráneo[7,8].

La resección subtotal fue el objetivo en este caso debido a la invasión de estructuras óseas y tejidos blandos. Los meningiomas con extensión extracraneal y transósea presentan un mayor riesgo de complicaciones quirúrgicas, y se ha demostrado que abordajes quirúrgicos complejos, como craneotomías orbitocigomáticas y resecciones en múltiples etapas, son necesarios para alcanzar una resección adecuada y reducir las recurrencias[4,9].

La mayoría de los meningiomas extracraneales son benignos y de grado I según la OMS, lo que coincide con el diagnóstico histopatológico de este caso. Sin embargo, su comportamiento invasivo hacia estructuras óseas y de tejidos blandos puede afectar el pronóstico. Los estudios sugieren que, aunque el pronóstico general de los meningiomas grado I es bueno, la invasión en áreas complejas puede aumentar la probabilidad de recurrencia y requerir seguimiento a largo plazo, así como tratamientos complementarios si persiste el riesgo de crecimiento tumoral residual[2].

Ki67 es una proteína nuclear asociada con la actividad mitótica, involucrada en todas las fases del ciclo celular, excepto la fase G0. Esta proteína ha demostrado ser eficaz para determinar la actividad proliferativa en meningiomas. Se utiliza rutinariamente en la práctica clínica debido a su asociación con el índice mitótico y el grado histopatológico en meningiomas. El índice de proliferación (IP) de Ki67 tiene una fuerte correlación con el crecimiento tumoral, la recurrencia y la supervivencia libre de enfermedad en varios tumores, incluidos los

meningiomas. El Ki67 es un complemento útil a la histomorfología en el diagnóstico de meningiomas. Los valores Ki67 >4% indica un grado tumoral más avanzado[12].

En los casos de meningiomas refractarios o con extensión significativa, la radioterapia puede ser una opción de control local postquirúrgico, especialmente en aquellos donde la resección completa no es posible. Nuevas técnicas como la ablación láser también han sido exploradas en casos complejos, aunque se necesitan más estudios para validar su efectividad en meningiomas con invasión extracraneal[8,10].

IV. CONCLUSIÓN

En conclusión, los meningiomas invasores de la región infratemporal representan una entidad rara y desafiante, con potencial de comportamiento agresivo y capacidad para invadir áreas extracraneales, tejidos blandos y estructuras faciales, independientemente de su grado histológico según la OMS. Este tipo de meningiomas plantea retos tanto diagnósticos como terapéuticos, ya que su presentación clínica es inespecífica y la invasión a regiones como la facial y epicraneal puede llevar a diagnósticos diferenciales complejos en los estudios de imagen. La resección quirúrgica de estos tumores representa un reto debido a su extensión, lo que subraya la importancia de un enfoque terapéutico multidisciplinario. Maximizar la resección tumoral es crucial para mejorar el pronóstico del paciente, por lo que es fundamental evaluar las opciones terapéuticas disponibles para lograr un control eficaz de la enfermedad en casos tan complejos.

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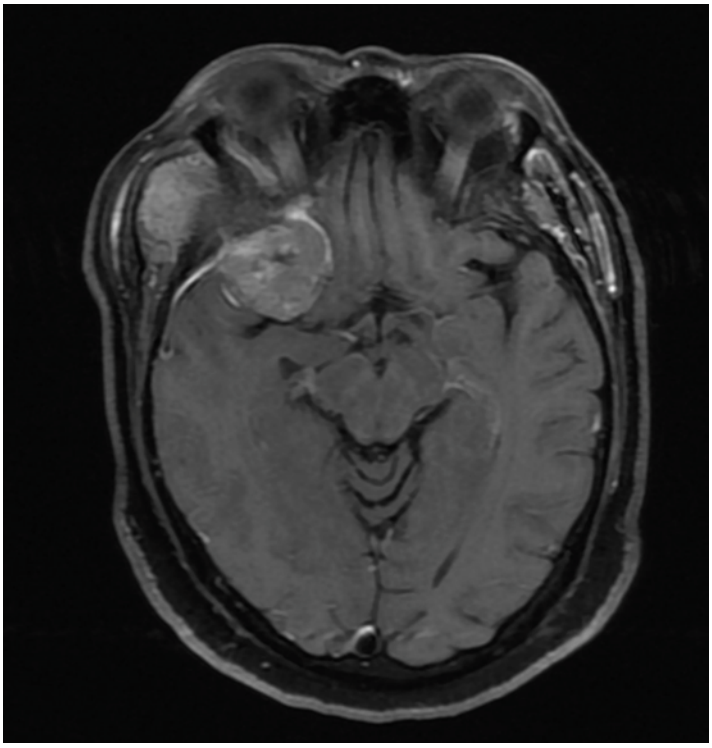
ANEXOS

Imagenes Preoperatorias:



Imagenes Postoperatorias

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Assessment of Nurses' Knowledge and Practice Regarding Intravenous Fluid Therapy on Adults in Orotta and Halibet National Referral Hospitals, Asmara, Eritrea, 2023

Anjana Kuriakose, Dr. Linto M Thomas, Alexander Zeresenay Teklegiorgis, Luwam Okubamichael Tekle, Mahmud Ibrahim Mahmud, Misghana Ghebrehiwet Tekeste & Natsnet Tedros Tekle

ABSTRACT

Introduction: Intravenous fluids are liquid substances that are administered in to the body's circulatory system via a vein. In hospitals intravenous therapy is the most common way of administration and providing fast and satisfying outcome. Nurses play important role in administering and managing IV therapy, however poor knowledge and practice of nurses can arise life threatening complications.

Aim: The aim of study is to assess nurses' knowledge and practice regarding IV fluids therapy in Orotta and Halibet National Referral Hospitals, Asmara, Eritrea.

Keywords: knowledge, practice, nurse and iv fluid therapy, adults.

Classification: NLM Code: WY100, WY154, WB354

Language: English

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Anjana Kuriakose[α], Dr. Linto M Thomas[σ], Alexander Zeresenay Teklegiorgis[ρ], Luwam Okubamichael Tekle[Ω], Mahmud Ibrahim Mahmud[¥], Misghana Ghebrehiwet Tekeste[χ] & Natsnet Tedros Tekle[v]

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Aim: The aim of study is to assess nurses' knowledge and practice regarding IV fluids therapy in Orotta and Halibet National Referral Hospitals, Asmara, Eritrea.

Methodology: Stratified random sampling was used to select the samples in this study. Each ward was taken us strata. Total sample size was 133. This research used a quantitative cross sectional analytical design. The data collection method was self-administered questionnaire and observational checklist. Data was analyzed by using SPSS (Version 26). Descriptive and inferential statistical tests were done as per the need of research objectives.

Result: The result revealed that The mean (SD) of knowledge of the nurses on IV fluid was 62.29 (11.06) while that of practice was 60.03(11.95). The factors affecting knowledge and practice on IV fluid were determined using independent samples T-test and one way ANOVA. The knowledge score among nurses aged 25 or less was significantly higher than those nurses in the age group 26 or above (t-value=2.086, p=0.039). However, the categories of sex (p=0.149), years of experience (p=0.289), educational level (p=0.376), and further IV therapy training (p=0.915) did not have significantly different knowledge scores. On the other hand, females had significantly higher practice score as compared to males by an average of 5% (t=-1.979, p=0.049). Moreover, at least one of the categories of the educational level was found to have significantly different practice score (F=4.523, p=0.013). However, practice score across the various categories of age (p=0.116), years of experience (p=0.526), further IV therapy training (p=0.791) were not significantly different.

Conclusion: Nursing practice related to the study concluded that the overall knowledge and practice of nurses has no significant correlation between knowledge and practice. Hence the fact that they have more knowledge does not guarantee more practice by the nurses. The knowledge score among nurses aged 25 or less was significantly higher than those nurses in the age group 26 or above. Therefore, efforts to transform nurses' knowledge into practice is an important concern for educational and awareness programs to improve knowledge and practice changes in regard to IV Fluids Therapy.

Implication to the field of nursing: The research findings will enable the organization to develop and organize training programs by identifying the gaps in knowledge and practices of nurses towards IV Fluids Therapy. Efficient knowledge and good practices by the nurses can facilitate patient hospital staying and may contribute to

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decrease the rate complication IV Fluids Therapy. Moreover, the study results will help for the further research in nursing profession.

Keywords: knowledge, practice, nurse and iv fluid therapy, adults.

I. INTRODUCTION

Background: Intravenous therapy (IVT) is the procedure that needs manual skills, professional competency, knowledge about the anatomy and physiology of vascular system. It is used more frequently for administration of different drugs, fluids, blood, nutrition, for sampling and other purposes. In clinical setting of hospital, nurses are believed to be accountable and responsible for handling and managing patient with it. (Sandhya & Rosy , 2019).

Intravenous fluids are liquid substances that are infused into the body's circulatory system via vein. (Frost,2015) and are classified as crystalloids, colloids, and blood products (Westbrook, J., Woods, & Parry, 2011). Fluid and electrolytes balance is crucial for physiology of human body and its normal functioning and metabolism. About 60% (60-67%) of the total body weight is made up of water. Electrolytes are such as sodium, potassium, chlorine, calcium, magnesium and phosphorus. On the other hand, colloids contain large molecules that do not cross semipermeable membranes, thereby remaining within the blood vessels as volume expanders due to their high oncotic pressure; examples include albumin and low-molecular- weight dextran.

The body's homeostatic control mechanisms ensure that a balance between fluid gain and fluid loss is maintained. (Chanak, Gayatri, & Siddheshwar, 2019). The infusions of fluids into the peripheral veins is often indicated when patients is unable to take fluid orally and there are different factors (Illness, trauma, surgery, age, gender, environmental temperature and medication, etc.), which affect the fluid and electrolytes balance and the mechanism of the body. Intravenous therapy is used to maintain or to restore fluid balance, to maintain or to replace electrolytes, administer water-soluble vitamins to provide a source of calories and nutrients, administer drugs and to replace blood and blood products. (Sajjad, Majid, & Mahfood, 2020).

Patient safety, which is one of the highest priority goals of patient treatment and care, is affected by various factors such as hospital environment, the complexity of the quality and the quantity of healthcare workforce, medical processes, technology, and team work. However, patients can be faced with various medical errors (Sezgin, 2007). Nurses are in charge of initiating, monitoring, and terminating fluid therapy. They also need to know and prevent complications caused by catheter inserted through a vein or resulted from intravenous fluid therapy. Nurses are needed to increase their knowledge and performance regarding intravenous (IV) fluid therapy to manage its possible complications and improve patient safety (Nazar & Abbas, 2020).

Basically there are two types of fluid imbalances i.e. over load and fluid volume deficit. Excessive fluid generates edema and is associated with organ dysfunction and even death. The compulsion to interpret all the evidence and observation according to the patient diagnosis as edematous patient may have a positive fluid balance but can be decrease intravascular fluid, which lead to the inadequate oxygenation and tissue perfusion (Chanak, Gayatri, & Siddheshwar, 2019).

Poor knowledge of IV infusion has the potential of jeopardizing the quality of care provided to patients and consequently lead to poor out-comes. In Kenya, inappropriate IV fluid therapy accounts for about 17% of deaths among hospitalized patients (Abwalaba, Ogutu, & Ng ang¸a, 2018). These errors have been linked to inadequacies in IV fluid therapy knowledge among health care workers, including nurses. Findings of a study conducted in 13 Kenyan hospitals showed that inadequate knowledge of IV fluid therapy among nurses is a risk factor for mortality and further demonstrated that improved knowledge significantly reduced the mortality of patients (Abwalaba, Ogutu, & Ng ang¸a, 2018; Frost, 2015; Westbrook, J ., Woods, & Parry, 2011)

1.1 Problem Statement

In most countries that has conducted research regarding IV fluid therapy has inadequate knowledge and practice. For example, in Iraq about 47.1% was inadequate knowledge (NazarandAbbas, 2020). In Nepal level of practice and knowledge 66.1% and 50.9% respectively (Sandhyalamsal and Rosyshrestha). In Malaysia majority of nurse about 62.5% did not have knowledge (Ahmed and Mohd, 2013).

Intravenous cannulation is more common and is invasive procedure among hospitalized patient However,it is associated with complications that can delay the prognosis and have an adversimpact on the clinical outcome of the patient, like infection, phlebitis, infiltration or extravasations, fluid overload, hypothermia, electrolyte imbalance, embolism. In most countries nurses knowledge and practice of IV-therapy is insufficient, despite the fact thathis study has not been conducted in Eritrea, our aim is to assess nurses knowledge and practice of regarding IV fluid therapy to promote patients' safety and to increase the quality of patient care.

1.2 Significance of the Study

Nurses plays major role in providing fluids via intravenous method. The intravenous route is the best and the fastest way for delivering fluids or drugs. It carries most risk than other routes, so it is important to reduce the risk, it is essential for the nurses to improve their ability and to practice effectively.

This study investigated the knowledge and practices of nurses towards prevention of complication of IV fluid therapy in Orrota and Halibet wards. First, this study has been helpful for us to improve our knowledge and practice for the IV fluid therapy during our clinical period. In addition, the research findings enabled the organization to develop and organize training programs by that identified the gaps in knowledge and practices of nurses towards prevention of complication of IV therapy. Efficient knowledge and good practices by the nurses can facilitate patient care and may contribute to decrease patient staying time in the hospitals. Moreover, the study results will help for the further research in nursing profession.

1.3 Justification of the Study

In our clinical postings and day to day experience, we found that the staff nurses provide IV fluids incorrectly. It is due to the lack of knowledge and proper awareness on IV fluid therapy. This ultimately leads to various complications on patients, loss of resources and many other problems to the health care delivery system. Therefore, the researchers decide to have study on the assessment of knowledge and practice level of nurses on IV fluid therapy. The researchers firmly believe that the study will act as a first step to solve the problem because finding the existing level of knowledge and practice of nurses help authority to provide various in-service programs to improve the efficiency of nurses on this regard. This ultimately improves the health care of our country too.

II. OBJECTIVES

2.1 General Objectives

The aim of the study is to assess the knowledge and practice of nurses on IV fluid therapy.

2.2 Specific Objectives

- To assess the level of knowledge of nurses on IV fluid therapy.
- To assess the level of practice on IV fluid therapy among nurses.
- To determine the relationship between knowledge and practice of nurses regarding IV fluid therapy.
- To determine the association between knowledge of IV fluids and selected socio-demographic variables.
- To determine the association between practice of IV fluid therapy and selected socio-demographic variables.

2.3 Research Question

1. What is the level of nurses' knowledge regarding IV fluid therapy?

2. What is the level of nurses' practice regarding IV fluid therapy?
3. What relationship exists between nurses' knowledge and practice towards an IV fluid therapy?

2.4 Operational Definitions

Knowledge: It is the existing information of nurses regarding IV fluid therapy measured using a self-administered questionnaire.

Practice: It is the existing ability or skill for nurses to perform IV fluid administration measured using an observational checklist.

Staff Nurse: The nurses working in adult wards of Orotta and Halibet hospital.

IV fluid therapy: Administration of IV fluids through IV cannula (RL, DNS, NS, D5etc).

Adults: Patient's admitted in selected hospitals whose age above 18years.

III. LITERATURE REVIEW

A descriptive and inferential study was done by L. H. Hiranandaniin (2018), as an aim to scrutinize best practices in infusion nursing among the nurses in a private tertiary care center hospital, India. A total of400 IV cannulation were evaluated on the basis of the IV therapy monitoring chart among the nurses. 20 nurses were included in the study. The result of knowledge score of the nurses regarding infusion practice were evaluated and it was founded in the 65 % of nurses were rated average and 35% poor.

A cross-sectional study design was done by Sandha and Rosey in (2019) as an aim to assess nurses' knowledge and practice regarding IV fluid therapy in teaching hospital Bharatpur, Nepal. Design was adapted with 177 nurses for assessment of knowledge and 53 nurses to observe on IV fluid therapy. A systematic random sampling technique was used. The level of knowledge was found inadequate and the level of practice was found unsatisfactory on IV therapy.

A descriptive cross sectional research design was done by Sajjad, Majid, Mahfoodin (2020), as an aim to assess nurses' level of education about IV fluid administration at Basrageneral hospital Iraq. On sampling of 300 nurses, more than half of the sample had a level of education of health institute most of the study sample had less than 10 years of employment most of the nurses had good knowledge about IV fluid, where they get high scoring, they haven't find any correlation between variable and the score they got.

A cross-sectional survey was done by Winfrindah Wangui and Elzabeth kalondo in (2021), as the aim to measure nurses' knowledge of basic aspects of intravenous fluids, in medical and surgical wards in County teaching hospital in Kenya among 52 staff nurses. The overall mean knowledge scores on IV fluid therapy by nurses at the adult medical and surgical wards was 57.4% (*SD* = ±28.55), which depicted a moderately adequate knowledge level. A higher proportion of the nurses (65%) had moderately adequate knowledge whereas 23% had inadequate knowledge regarding IV fluids.

Descriptive study desiegn was conducted in Egypt by wafaa EL-said Ouda, Prof.Manal Farouk Mahmoud, Dr Rihab Hassan Kafl, Dr. Hadeer Hussien Soliman, Msc.(2019). The aim of the study was to investigate nurses knowledge & practice regarding peripheral IV Cannulation & blood sampling in pediatric ICU AIN Sham University on 81 nurses. The result was half of the studied nurses had satisfactory regarding cannulation and blood sampling while the majority of them had unsatisfactory practice.

A comperative study was conducted in Iraq Hawler Medical university by Nazar Rmadhan Othman, Abbas Abdulqadr(2020). The aim was to compare nurses knowledge, Attitude and practice concerning fluid therapy in children in public versus private Hospitals in Erbil city the result was in knowledge, attitude, practice in public hospital were poor,while the nurses from private hospitals had an acceptable level of knowledge,attitude and practice of iv fluid therapy.

Descriptive study was conducted in university Hospital Turkey by Aysegul Gunes & Sevilay Senonolcelik. The aim of the study was to examine knowledge and practice of nurses

concerning IV K admistration on 105 nurses. The result was mean score knowledge was 9.48 and for practice 10.85.

Descriptive cross sectional was conducted by Sajjad Selim Issa, Majid Abdulwahab Haattook, Mahfood Falih 2022. The aim of the study was assessment of nurses knowledge about intravenous fluids administration at Basra general Hospital Iraq. Study was conducted among 300 nurse's. The reasult revealed that most of the nurses has good knowledge.

Descriptive cross sectional research design was conducted by Chanak Trikhatri, Gayatri Rana and Siddheshwars. Angadi in Nepal (2019). The aim of the study was knowledge and practice regarding fluids and electrolytes administration among 110 nurses working in teaching Hospital Chitaw. The result was average mean score of knowledge and practice 45% and 65.2%.

Descriptive cross sectional research design was conducted by Mohammed MA, Elshamy KF and Mohammed HAB in Egypt(2019). The aim of the study was effect of implementing IV Fluids Therapy protocol among 123 nurses knowledge and performance at specialized medical Hospital. The result that revealed adequate knowledge but poor on performance to follow protocols.

IV. METHODOLOGY

4.1 Study Design

Cross sectional analytical study design was used to conduct the knowledge and practice of nurses regarding IV Fluid Therapy at the two National Referral Hospitals (Orotta and Halibet) in Asmara, Eritrea. Quantitative study approach was employed to assess the knowledge and practice of the nurses. The study was conducted from February 2023 to April 2023.

4.2 Study Area

Hospital based setting in the capital city of Eritrea, Asmara, is planned in order to conduct the study. Asmara is located in the latitude and longitude 15020' N and 38056' E respectively, and sits at an elevation of 2325 meters (7628ft) above sea level. Its total population in 2018 was estimated to be 896,000. It has two main national referral hospitals. Those hospitals are Orotta and Halibet National Referral Hospitals.

ONRH has 255 beds in adult inpatient department while in Halibet referral hospital has the total number of 181 beds.

4.3 Study Population

Staff nurses who work in Orotta and Halibet Hospital adult inpatient wards was constitute the target population for the study. The wards in Orotta are generally classified as Medical, Surgical, Emergency, ICU, Recovery, Maternity, Oncology, ENT and Halibet wards are Burn, emergency, ward-A, ward-C, prison-ward, ward-MB, ward-G, and recovery.

Table 1: Number of Beds and Number of Staff Nurses in Onrh and Hnrh

OROTTA		
WARD	No. of Beds	No. of Staff Nurses
ENT	20	7
GYN	32	9
PO	31	9
PP	12	8
S2B	24	8
S2A	35	8
MA3	35	8
MB3	24	8
ICU Adult	9	16
Recovery	8	7
ER Adult	25	27

HALIBET		
Burn	17	5
Emergency	22	7
Ward A	24	8
Ward C	15	7
Orthopedic A	18	7
Orthopedic B	14	5
Orthopedic OR	16	12
General OR	16	12
Ward G	30	5
Recovery	9	5

4.4 Sample Size and Sampling Method

Determination of sample size; the sample should be representative of the target population and of sufficient size to produce meaningful results and to allow tests of statistical significance to be applied**.**

Sample size was calculated using the one proportion sample size formula as:

$$n= \frac{NZ^2pq}{d^2(N-1)+pqZ^2}$$

Where n = sample size

N = total number of target population

Z_a= standardized normal score

p = probability of participants who have CVS

q = probability of participants who does not have CVS

d = margin of error

Based on a 95% CI, 5% margin of error, an expected proportion of 0.5 (since no previous studies were conducted), and population size of 188, the sample size is:

$$n= 188*1.92*0.5*0.5/0.05*(188-1)+0.5*0.5*1.96$$
$$=126.4 \approx 127$$

After considering 5% non-response rate, a final sample size of 133 students will be selected.

Stratified random sampling will be used to select the samples from each ward so as to have representative samples. Each ward will be taken as strata because of the similarity that exist among workers of the same ward.

The computed sample size will be allocated using proportional allocation as:

$$n_i = nN_i/N$$

Where: $\mathbf{N_i}$= total number of students in each stratum

$\mathbf{n_i}$= sample size of the allocated stratum.

The samples distributed as per the hospital and ward is displayed at Table 2.

Table 2: Distribution of Total Nurses and Samples by Hospital and Ward

Hospital	WARD	No. of Staff Nurses	Sample of Nurses
OROTTA	ENT	7	5
	GYN	9	6
	PO	9	6
	PP	8	6
	S2B	8	6
	S2A	8	6
	MA3	8	6
	MB3	8	6
	ICU Adult	16	10
	Recovery	7	5
	ER Adult	27	18
	Burn	5	4
	Emergency	7	5

Halibet	Ward A	8	6
	Ward C	7	5
	Orthopedic A	7	5
	Orthopedic **B**	5	4
	Orthopedic OR	12	8
	General OR	12	8
	Ward G	5	4
	Recovery	5	4

4.5 Criteria for Selectio

Inclusion Criteria: Staff nurses currently working at Orotta and Halibet Hospitals.

4.5.1 Exclusion Criteria

- Head nurses
- Nurses not actively involved at patient care
- Nurses working in pediatric wards
- Nurses who are not willing to participate in the study

4.6 Data Collection Tools and Methods

A structured standard questionnaire (Fernandez, 2009) tool was adapted after necessary modifications to assess the knowledge and a standard observational check list from Eritrean nursing procedure guide lines was used to assess practice.

Demographic characteristics: sex, age, work experience, level of education, further training on IV therapy

Knowledge assessing items: 7 back ground questions 18 response questions

Practice assessing items: 7 back ground same knowledge assessing & 24 observational checklist

4.7 Study Variables

Socio-demographic variables

- Sex, Age, Work Experience, Level Of Education, Further Training on IV-Therapy

Research variables

- Knowledge of IV-Fluid Therapy, Practice of IV-Fluid Therapy

4.8 Pilot study

The pilot study was done in Sembel Hospital in Asmara. This study was aimed at assessing the feasibility of the study, validity, sensitivity and understandability of the data collection instrument. The sample for pilot study was 10% of general study sample size.

4.9 Validity

The face and content of validity of the items that assess knowledge and practice of IV fluid therapy was be done by panel of experts in the field, from Orotta College of Medicine and Health Science, and Ministry of Health**.**

4.10 Reliability

The internal consistency of the questionnaire regarding knowledge and practice, Cronbach's alpha was computed. It was performed using Cronbach's alpha. Values that are greater than 0.6 are usually considered to be acceptable in perception related studies.

4.11 Ethical consideration

Permission for the study will be taken from the Research and Ethics Committee of Orotta College of Medicine and Health Sciences and subsequently by the Committee in Ministry of Health. Then, approval from the head departments of the OROTTA and HALIBET national referral hospital wards will be sought. Staff members will be asked to participate voluntarily through written formal consent. All nurses will be informed that they have the right to leave, if inconveniences exist. Furthermore, there will be a confirmation on confidentiality of the collected data

4.12 Statistical Analysis

Data was directly entered to SPSS (Version 25) after being cleaned properly. The descriptive analysis was performed using frequency and percentage for categorical variables. The

quantitative variables was analyzed using mean and median along with their measures of dispersion, as appropriate after checking normality. The scores of knowledge and practice on intravenous fluid therapy was computed from each nurse. To compare the knowledge and practice score across the categories of the independent variables, independent samples t-test and one-way ANOVA was used. P-value less than 0.05 was considered as significant throughout the analysis.The variables that are significant at bivariate level was further analyzed at multiple logistic regression to avoid their confounding effect. Crude and adjusted odds ratio was computed to assess the strength and direction of association.

V. ANALYSIS AND RESULTS

5.1 Socio-Demographic Characteristics

The socio-demographic characteristics of the study participants are displayed in Table 3. The median age of the nurses was 25 years (IQR=6) in which almost half (51.9%) were in the age group 25 or less. Almost seven out of ten (72.2%) of the nurses were females and median years of experience was 4.0 years (IQR=5). Most of the nurses were at diploma level (54.9%) and did not get any further IV therapy training (61.7%).

Table 3: Socio-Demographic Characteristics of the Study Participants

Variable		Frequency	Percentage
Age, years (Md=25.00, IQR=6, Min.=20, Max.=50)			
	25 or less	69	51.9
	26 or above	64	48.1
Sex			
	Male	37	27.8
	Female	96	72.2
Years of experience (Md=4.0, IQR=5, Min.=1, Max.=25)			
	5 or less	86	64.7
	More than 5	47	35.3
Educational level			
	Bachelor	8	6
	Diploma	73	54.9
	Certificate	52	39.1
Further IV therapy training			
	Yes	51	38.3
	No	82	61.7

5.2 Knowledge of Nurses on IV Fluid

The knowledge of the nurses in an item-wise is displayed in Table 4. The percentage of nurses who correctly answered that an IV fluid contains blood, fluid and solutions, only fluid and albumin were 21.1%, 95.5%, 88.7%, and 5.3% respectively. The classification of an IV fluid was correctly answered by 60.9% of the nurses. Less than half (42.9%) of the nurses were able to correctly differentiate crystalloid from colloid. More than six out of ten (63.9%) were able to correctly know the identification mechanism of type of colloid. Identification of crystalloid was correctly known by ninety percent of the nurses (90.2%). Moreover, the most physiologic IV fluid (81.2%), description of the term isotonic (79.7%), an ion not contained in RL solution (85.7%) were correctly known by almost eight out of ten nurses. Other items related to knowledge and their percentage distribution is displayed in Table 4.

Table 4: Percentage Distribution of Nurses on their Knowledge Regarding IV Fluid, Item-Wise Analysis

Question		Incorrect n(%)	Correct n(%)
What an IV fluid contains			
	Blood	105 (78.9)	28 (21.1)
	Fluid and solutions	6 (4.5)	127 (95.5)
	Only fluid	15 (11.3)	118 (88.7)
	Albumin	126 (94.7)	7 (5.3)
Classification of IV fluid		52 (39.1)	81 (60.9)
Difference between crystalloid from colloid		76 (57.1)	57 (42.9)
Identification of type of colloid		48 (36.1)	85 (63.9)
Identification of crystalloid		13 (9.8)	120 (90.2)
Know the most physiologic IV fluid		25 (18.8)	108 (81.2)
Description of the term isotonic		27 (20.3)	106 (79.7)
Knowing an ion not contained in RL solution		19 (14.3)	114 (85.7)
Most relevant IV fluid for a patient with profuse watery diarrhea		45 (33.8)	88 (66.2)
Most relevant IV fluid for a vomiting of ingested material frequently and presented to ER		106 (79.7)	27 (20.3)
Most prefered IV fluid for a patient with decreased glucose in blood and increased Na in blood		14 (10.5)	119 (89.5)
Know the human body that mainly monitor fluid balance		21 (15.8)	112 (84.2)
Manifestations of hypovolemia		42 (31.6)	91 (68.4)
Infusion rate in micro drip set		44 (33.1)	89 (66.9)
Complication of IV fluid therapy			
	Thrombophlebitis	79 (59.4)	54 (40.6)
	Infiltration	93 (69.9)	40 (30.1)
	Air embolism	54 (40.6)	79 (59.4)
	Thrombus embolism	94 (70.7)	39 (29.3)
Risk of administering reapid hypertonic solution for a patient with trauma or hyponatremia			
	Cerebral edema	25 (18.8)	108 (81.2)
	Hypokalemia	112 (84.2)	21 (15.8)
	Hypomagnesemia	9 (6.8)	124 (93.2)
	Hyperventilation	8 (6.0)	125 (94.0)
Know the sequestration of excess isotonic fluid into tissue spaces		56 (42.1)	77 (57.9)
Time the intravenous tubing should be changed to minimize the risk of phlebitis		40 (30.1)	93 (69.9)

5.3 Nurses Practice on IV fluid

The practice of nurses was collected after observing the nurses on the clinical area by the researchers. The activities or practices that they were supposed to perform were recorded one after the other to the observational checklist. The result is displayed in Table 5.

Almost ninety percent (88.7%) of the nurses were able to check physician order and nursing care plan. However, almost one fourth (27.1%) of the nurses were observed to identify, greet, introduce his/herself and explain the procedure. More than ninety percent of the nurses were observed to attach tubing to bottle solution and hang it on the IV stand (90.2%), open the regulator and removal air bubbles from the tube and close the regulator (94.7%), place to urniquet above selected site of the arm (94.0%), put on gloves, locate vein with your fingers and the site with antiseptic (95.5%),

remove tourniquet if blood comes and open regulator (97.0%) and insert cannula into the vein and observe if blood comes through the needle (99.0%).

On the other hand, less than thirty percent of the nurses were observed to assist the patient comfort position and place Rx rubber and cover under arm or under the area to be injected (21.8%), calculate drop factor and set the rate accordingly (23.3%), and return to client frequently to evaluate response and adverse reaction (29.3%).

Table 5: Percentage Distribution of Nurses' Practice on IV Fluid, Item-Wise Analysis

Observational items	Yes n (%)
Check physician order and nursing care plan	118 (88.7)
Identify, greet, introduce his/herself and explain procedure	36 (27.1)
Wash hands, before assembling equipment and supply for administering IV fluid and take it to the bed side	60 (45.1)
Check the patient card and assess patient condition in relation to the IV fluid ordered	84 (63.2)
Describe the objective of administering IV fluid	65 (48.9)
Attach tubing to bottle of solution and hang it on the IV stand	120 (90.2)
Open and clean stop per of solution bag	35 (26.3)
Assemble, equipment and supply for administering IV fluid and take it to the bed side table	111 (83.5)
Attach the IV fluid level (date, time, types of solution amount of fluid order per hour	93 (69.9)
Open the regulator and removal air bubbles from the tube and close the regulator	126 (94.7)
Attach the covered needle to tubing	87 (65.4)
Assisst the patient comfort position and place Rx rubber and cover under arm or under the area to be injected	29 (21.8)
Place to urniquet above selected site of the arm	125 (94.0)
Put on gloves, locate vein with your fingers and the site with antiseptic	127 (95.5)
Insert cannula in to the vein and observe if blood comes through the needle	132 (99.2)
Remove tourniquet if blood comes and open regulator	129 (97.0)
Calculate drop factor and set the rate accordingly	31 (23.3)
Assist client in comfortable position and ask the client for any sensations	64 (48.1)
Dispose used materials in safe disposal	103 (77.4)
Clean and return other equipment and supplies in proper place	94 (70.7)
Wash hand after procedure	40 (30.1)
Return to client frequently to evaluate response and adverse reaction	39 (29.3)
Record and report (type of solution, amount, route, site, time, response of client and any medication aid)	68 (51.1)

5.4 Composite Knowledge and Practice on IV Fluid of the Nurses

Overall knowledge of the nurses on IV and their practice scores were computed after assigning the necessary value for each item. There were a total of 18 questions resulting to 27 scores for the knowledge assessing questionnaire. On the other hand, there were a total of 24 questions resulting to 24 scores for the practice assessing questionnaire. Finally, for an ease of interpretation, the scores are transformed to percentage. After computing the total scores, the normality of the scores was checked; with skewness (kurtosis) values for knowledge and practice being -0.443 (0.781) and -0.520 (-0.212), respectively; they were taken as normally distribued.

Table 4.4 shows the summary measures of the knowledge and practice scores. The mean (SD) of

knowledge of the nurses on IV fluid was 62.29 (11.06) while that of practice was 60.03(11.95).

The result shows that six out of ten of the knowledge items were known by the nurses. Similarly, six out of ten of the practice assessing questions was being practically applied by the nurses, after being observationally measured.

Table 6: Summary Measures of the Composite Knowledge and Practice Scores of Nurses

Variable	M (SD)	Md (IQR)	Minimum	Maximum
Knowledge	62.29 (11.06)	62.96 (14.81)	25.93	88.89
Practice	60.03 (11.95)	62.50 (12.50)	33.33	83.33

5.5 Factors Affecting Knowledge and Practice on IV Fluid

The factors affecting knowledge and practice on IV fluid were determined using independent samples T-test and one way ANOVA. The results from the analysis are displayed in Table 7.

The knowledge score among nurses aged 25 or less was significantly higher than those nurses in the age group 26 or above (t-value=2.086, p=0.039). However, the categories of sex (p=0.149), years of experience (p=0.289), educational level (p=0.376), and further IV therapy training (p=0.915) did not have significantly different knowledge scores.

On the other hand, females had significantly higher practice score as compared to males by an average of 5% (t=-1.979, p=0.049). Moreover, at least one of the categories of the educational level was found to have significantly different practice score (F=4.523, p=0.013). However, practice score across the various categories of age (p=0.116), years of experience (p=0.526), further IV therapy training (p=0.791) were not significantly different.

Table 7: The Difference in Knowledge and Practice Scores Across the Categories of Demographic Variables among Nurses Who Work in Orotta and Halibet Referral Hospitals

Variable		Knowledge	Practice
		M (SD)	M (SD)
Age, years			
	25 or less	64.20 (10.26)	61.59 (12.44)
	26 or above	60.24 (11.60)	58.33 (11.26)
	t-value	2.086	1.581
	p-value	0.039*	0.116
Sex			
	Male	60.06 (10.15)	56.76 (12.16)
	Female	63.16 (11.33)	61.28 (11.69)
	t-value	-1.452	-1.979
	p-value	0.149	0.049*
Years of experience			
	5 or less	63.05 (10.82)	60.51 (13.11)
	More than 5	60.91 (11.48)	59.13 (9.54)
	t-value	0.556	0.636
	p-value	0.289	0.526
Educational level			
	Bachelor	67.59 (12.00)	48.96 (7.63)

	Diploma	61.85 (9.85)	61.76 (11.03)
	Certificate	62.11 (12.46)	59.29 (12.88)
	F-value	3.984	4.523
	p-value	0.023*	0.013*
Further IV therapy training			
	Yes	62.16 (12.27)	60.38 (10.55)
	No	62.38 (10.32)	59.81 (12.80)
	t-value	-0.107	0.266
	p-value	0.915	0.791

Post hoc test results using Least Significant Difference (LSD) method showed that nurses at degree level have significantly lower practice as compared to those at diploma level (MD=-12.80, 95% CI: -21.38, -4.22). Moreover, nurses at degree level have significantly lower practice score as compared to those at certificate level (MD=-10.34, 95% CI: -19.09, -1.59). However, nurses at diploma and certificate level had similar practice score (p=0.246). The results are displayed in Table 8.

Table 8: Post Hoc Test Result Using Least Significant Difference (Lsd) Method

Comparison	MD (95% CI)	p-value
Bachelor Vs Diploma	-12.80 (-21.38, -4.22)	0.004
Bachelor Vs Certificate	-10.34 (-19.09, -1.59)	0.021
Diploma Vs Certificate	2.46 (-1.72, 6.64)	0.246

5.6 Multi Variable Determinants of Practice Score

The factors that affect the practice score after controlling the confounding effect of each other was performed using two way analysis of variance. The two variables that were significant at bivariate level, namely, sex and educational level, were retained for multivariable analysis. The result showed that only educational level was a significant determinant of the practice score (p=0.016), but not sex (p=0.065).The results of the two-way ANOVA are given in Table 9.

Table 9: Factors Affecting Practice Score at Multivariable Level

Variable	F-value	p-value
Sex	3.47	0.065
Educational level	4.287	0.016

5.7 Correlation between Knowledge and Practice of IV Fluid

The correlation between the knowledge and practice scores was calculated using pearson's correlation coefficient, since both scores were normally distributed. The result revealed that there was no significant correlation between knowledge and attitude (r=0.016, p=0.858, n=133). Hence, the fact that they have more knowledge does not guarantee more practice by the nurses.

VI. DISCUSSION

5.8 Knowledge of Nurses on IV Fluids Therapy

The result that found on this study on assessment of nurse's knowledge regarding IV fluids is M(SD) 62.29%. The result is similar with those of recent study by Winfrindah in kenya (2021) which found that the majority of nurse knowledge is M(SD) 65%. The reason for this current result could related low educational level. The second reason could be lack of refreshing training for the staff

nurses that are organized by the Ministry of Health or the Hospital. Similar result revealed in another study by Victan (2013) in which 88.8% of nurses were having training on IV therapy were more knowledgeable than those who don't have.

5.9 Practice of Nurses on IV Fluids Therapy

In the present study, the practice regarding IV fluid therapy among nurses Orotta and Halibet referral Hospital is M(SD) 62.50%.The result was similar to another study by Sandhya and Rosy(2019) in Nepal, which found that practice was M(SD) 66.1%. The reason for this result could be the nurse were not practicing appropriate protocols in administering IV fluids. In concern with the availability of guide lines on fluids and electrolytes administration they didn't follow the protocol at the same time there were lack of adequate performance evaluation by the supervisors. Similar study done by Mohammed, Elshamy and Mohammed HAB(2015) the result revealed that the nurses were increased their performance on IV Fluids therapy administration after implementation of the procedure protocol. Second reason could be educational qualification. In contrast to this study. Another study by Bharatpur by Lamsal and Shretah (2019) revealed that the nurses practice level was M(SD) 33.9%.

5.10 Demographic Factors Affecting Knowledge and Practice on IV Fluids Therapy

This research found that there was association of knowledge with age (P=0.039). A similar finding have been reported by lamsal and shretah (P=0.012) in Chetaw. It is significantly associated with age which is consistent with the works of West Brook et.al (2011) that demonstrates 10.9% reduction in IV Therapy related nursing errors with increasing age. This indicated that nurses forget the information they acquire during nursing over time.

Educational level is highly correlated to IV fluid knowledge with Bachelor nurses scores M(SD) 67.59% but in diploma M(SD) 61.89% and certificate M(SD) 62.11%.Bachelor verses diploma (P=0.023) and this aligns with previous study by Winfrindah and Elizabeth in Kenya (2021) Bachelors M(SD) 79.7% in diploma M(SD)50.6% in certificate M(SD) 41.9%(P=0.001). The reason that reflect this consequence is in increasing level of education there is broader theoretical base followed by yearlong internship.

There was negative correlation practice with level of education and the result that revealed is bachelors M(SD) 48.96%, diploma M(SD) 61.76% and certificate M(SD) 59.29%. Bachelor verses Diploma (P=0.004) and Bachelor verses certificate (P=0.21). However another study by Chanak et al(2019) in Chetaw found that Bachelors M(SD) 80% and Diploma M(SD) 63.3%(P=0.001).

The result that found in this present study on the association of sex with practice, females had significantly higher practice score as compared with males (P=0.049). The reason may be female nurses were more cooperative than males regarding participating in research process. The result is similar with previous study was done in Basra Iraq (2022). The second reason may be by using maltivariable determinants of practice score sex is influenced by level of education so most female nurses are Diploma or Certificate.

The study revealed that there is no significant association among knowledge and practice with further IV Therapy training (P=0.915) and (P=0.791). Unlike previous study done by Lamsal and Shretah (2019) there was significant association between knowledge and in-service training which is (P=0.033). The reason may be the training is not given frequently and they were not serious about further training. Another reason could be the performance evaluation of in-service training is not done.

5.11 Correlation between Knowledge and Practice of IV Fluids Therapy

The study result reveals that no significant correlation between level of knowledge and practice. The correlation between the knowledge and practice scores was calculated using Pearson correlation coefficient, since both scores were normally distributed. The result revealed that there was no significant correlation between knowledge and practice(r=0.016, P=0.858,

n=133). Hence the fact that they have more knowledge does not guarantee more practice by the nurses. Similarly a previous study was done by Chanak Gayatri and Siddheshwar (2019) revealed that there was no significant correlation between knowledge and practice (P=0.170). The reason could be nurses don't have interest to update their knowledge through reading and studying.

VII. CONCLUSION AND RECOMMENDATION

7.1 Conclusion

The study was conducted to assess the level of knowledge and practice towards level of knowledge and practice regarding IV Fluids therapy among nurses at Orrota and Halibet national Referral Hospitals at Asmara in Eritrea. Data were collected from 133 nurses using self administered questionnaire to assess knowledge and observational check list to assess practice.

The study concluded that the knowledge and practice of nurses has no significant correlation between knowledge and practice. Hence the fact that they have more knowledge does not guarantee more practice by the nurses. The knowledge score amog nurses aged 25 or less was significantly higher than those nurses in the age group 26 or above.

The socio demographic variables (age, level of education) have significant value on the knowledge. The socio-demographic variables (Sex, level of education) has significant value on the practice of nurse. In contrast level of training does not show significant value on knowledge and practice of IV Fluids Therapy. Nursing practice and knowledge regarding IV Fluids Therapy is not satisfactory. Therefore improving nurses' knowledge and practice by instating educational program is important and in addition close monitoring and instituting motivation is important.

7.2 Recommendation

- A well-structured in-service educational programs for nurses to improve knowledge and skill on IV fluid therapy.
- Adequate supervision and support for improving skills of IV fluid therapy
- Ensure adequate supply of materials to practice safe IV fluid therapy
- Provision of the evidence based knowledge and practice of nurses regard to IV fluid therapy.

The study recommends continuing ion service program should be the success full strategies of improving knowledge and practice.

Limitation

- In this study there was constraints in time.
- This study was limited to specific departments of selected hospitals.

Implication to the field of nursing

The research findings will enable the organization to develop and organize training programs by identifying the gaps in knowledge and practices of nurses towards improving knowledge and practice among nurses IV Fluids Therapy. Efficient knowledge and good practices by the nurses can improve patient health minimize patient staying in Hospital and prevent complications related IV Fluids Therapy. Moreover, the study results will help for the further research in nursing profession.

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Appendex:- Questionnaire

Part I: Assessment of knowledge of respondents on IV Fluid Therapy.

Q101. Hospital name _____

Q102. Name of the respondent

Q103. Sex of the respondent: 1. Male 2. Female

Q104. Age of the respondent in completed years? _____

Q105. Work experience in completed years? _____

Q106. Level of education? 1. Bachelor's degree 2. Diploma 3. Certificate

Q107. Further IV therapy training? 1. Yes 2. No

Part II: Knowledge Assesment of IV-fluids Therapy

1. What is iv fluid? (multiple answer are possible)
   a. contains blood b. contains fluid &solute(ions)
   c. only contains fluid d. albumin
2. What are the clasificatin of iv fluid?
   a. B Blood & colloid b. blood & crystalloid
   c. blood, crystalloid & colloid d. crystalloid & colliod
3. What are the main diference/s of crystalloid from collid?
   a. hypertonic b. contain small molocules
   c. contain large molecule d. hypotonic
4. Which one of the folowing is colloid?
   a. RL b. NS c. dextros d. albumin e. others
5. Which one of the folowing is crystalloid?
   a. albumin b. blood c. NS d. gelatin
6. What is the most physiologic iv fluid?
   a. NS b. RL c. 3%NS d. dextros
7. Which of the folowing describe the term isotonic?
   a. a solution that has the same concentration as does blood plasma
   b. the natural tendency for substance to flow from an area of higher concentration to an area of lower concentration
   c. a solution that has ahigher concetraion of K+ than does the cell
   d. a solution that has lower concetration of Na than the cell
8. Which ion is not contained in RL solution?
   a. K+ b. Na c. Cl- d. c (carbon)
9. Patient A is presented with profuse watery diarrhea for the last 2 days what is the most indicated iv fluid for this pt?
   a. NS b. RL c. 5%DW d. DNS
10. Patient B is complaining of vomiting of ingested material frequently & presented to ER what is the most indicated iv fluid?
    a. NS 0.9% b. DNS c. RL d. NS 3%
11. When a patient presented with decreased glucose in blood & increased Na in blood then what is the most preferred iv fluid?
    a. DW b. RL c. NS d. DNS e. others

12. What are the two systems in the human body mainly monitored to assess the fluid balance?
    a. circulatory & renal b. respiratory & circulatory
    c. renal & gastrointestinal d. hepatic & lymphatic
13. All are manifestation of hypovolemia except?
    a. cold & clammy skin b. hypotension c. tachycardia d. bradycardia
14. The physician orders a continuous infusion of NS 800 ml/shift(8hour).calculate the infusion rate in macro drip set(15gtt)/ml?
    a. 25gtt/min b. 26gtt/min c. 27 gtt/min d. 28gtt/min
15. What are the complication of iv fluid therapy?
    a. thrombophlebitis b. infiltration c. air embolism d. thrombus embolism
    e. others
16. What will be the potential risk if administered rapid hypertonic solution for a patient with trauma or hyponatremia ?
    a. cerebral edema b. hypokalemia c. hypomagnesemia d. hyperventilation
    e. others
17. The sequestration of excess isotonic fluid in to tissue spaces are often referred to as?
    a. hypervolemia b. fluid retention c. dehydration d. hypernatremia
18. To minimize the risk of phlebitis the intra venous tubing (line) should be changed every _____hrs ?
    a. 10-12hrs b 12-24hrs c 24-48hrs d. 48-72hrs

Part III: Practice Check Observation List

SR. NO	Items	Yes	No
1	Does he/she check physician order and nursing care plan		
2	Dose he/she identify, great, introduce his/herself and explain procedure		
3	Does he/she wash hands, before assembling equipment and supply for administering iv fluid and take it to the bed side		
4	Does he/she check the patient card and assess patient condition in related the iv fluids that ordered		
5	Does he/she describe the objective of administering iv fluid		
6	Does he/she attach tubing to bottle of solution and hang it on the iv stand		
7	Does he/she open and clean stop per of solution bag		
8	Does he/she, assemble equipment and supply for administering iv fluid and take it to the bed side table		
9	Does he/she attach the iv fluid level (date, time, types of solution amount of fliud order per hr)		
10	Does he/she open the regulator and removal air bubles from the tube and close the regulator		
11	Does he/she attach the covered needle to tubing		
12	Does he/she assisit the patient comfort position and place Rx rubber and cover under arm or under the area to be injected		
13	Does he/she place to urniquet above selected site of the arm		
14	Does he/she put on gloves, locate vein with your fingers and the site with antiseptic		
16	Does he/she insert cannula in to the vein and observe if blood comes through the needle		
17	Does he/she remove tourniquet if blood comes and open regulator		
18	Does he/she calculate drop factor and set the rate accordingly?		
19	Does he/she assist client in comfortable position and ask the client for any sensations		
20	Does he/she dispose used materials in safe disposal		
21	Does he/she clean and return other equipment and supplies to the in proper place		
22	Does he/she wash hand after procedure		
23	Does he/she return to client frequently to evaluate response and adverse reaction		
24	Does he/she record and report (type of solution, amount, route, site, time, response of client and any medication add		

Immunological Markers of Practically Healthy Persons' Visual Analyzer State

Pleskanovskaya S. A., Annanepesov K. O., Karanov S. K., Agamedov M. A., Tantasheva A. M. & Karanov S. K

Medical University of Turkmenistan

INTRODUCTION

The eyes are a set of sensory organs that play a crucial role in the visual system [1]. Visual stimuli from our environment are processed by a complex system of interconnected neurons that begins with the optic nerve in the eye and extends to the visual processing center in the forebrain - the visual cortex [2].

The eye is an extension of the brain and contains nerve tissue in the light-sensitive layer, the retina, which is related to brain tissue, and the outer membrane are an extension of the medulla [3]

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Pleskanovskaya S. A.[α], Annanepesov K. O.[σ], Karanov S. K.[ρ], Agamedov M. A.[ω], Tantasheva A. M. [¥] & Karanov S. K [χ]

Author α: Myrat Garryev State Medical University of Turkmenistan, Research Center, Ashgabat, Turkmenistan.
σ: International Eye Disease Treatment Center of Turkmenistan, Head of the Center, Ashgabat, Turkmenistan.
ρ: Myrat Garryev State Medical University of Turkmenistan, Head of Eye Diseases Department, Ashgabat, Turkmenistan.
ω: Myrat Garryev State Medical University of Turkmenistan, Department of Neurology and Neurosurgery, Ashgabat, Turkmenistan
¥: V. A. Almazov NMRC, Department of Neurology, Saint-Petersburg, Russia.
χ: RUDN University, Department of Eye Diseases, Moscow, Russia.

I. INTRODUCTION

The eyes are a set of sensory organs that play a crucial role in the visual system [1]. Visual stimuli from our environment are processed by a complex system of interconnected neurons that begins with the optic nerve in the eye and extends to the visual processing center in the forebrain - the visual cortex [2].

The eye is an extension of the brain and contains nerve tissue in the light-sensitive layer, the retina, which is related to brain tissue, and the outer membrane are an extension of the medulla [3]. The optic nerve has capillaries that have barrier properties due to the presence of dense interendothelial cell connections. In addition, the optic nerve has a well-developed, hemato-tissue barrier, which is formed by the pial vessels, the intermediate tissue of Kunt and the border tissue of Jacobi, located between the chorioidea and the optic disc (OD). All of these tissues are composed of astrocytes. However, the blood-tissue barrier has defects, which allows some substances, including antigens, to penetrate through it choriocapillary endothelial cells' fenestrations also contribute to the penetration of various substances into the bloodstream [4, 5, 6].

Most of the biological material is freely filtered through the tissue of the Jacobi tissue border and enters the optic nerve prelaminar region [3, 7, 8]. Thus, there is a circulation of certain substances from eye's certain compartments into the bloodstream and from the bloodstream into the eye's compartments, including the visual analyzer tissues. Consequently, the nervous tissues of the eye are not adequately protected from the body's innate immune system.

The eye is one of several organs and tissues with immune privileges [9, 10]. The term "immune privilege" was introduced by Peter Medawar to show that the eye is exempt from the laws of transplantation immunology. Nevertheless, the impetus for the term came from the research of Dutch ophthalmologist van Doormal more than 150 years ago. In experiments on mice, he showed that the eye's anterior chamber protects allografts from rejection by the body's immune system [18]. Anterior chamber's this feature was the impetus for the study eye's immune system and its interaction with the innate immune system [11, 12].

Immune privilege is an active process in which certain tissues and the innate immune system cooperate to protect the eye from autoaggressive damage. The mechanisms that contribute to immune privilege include primarily tolerance of peripheral T-cells. Antigens entering the eye are taken up by local antigen-presenting cells, which migrate through the blood and initiate an immune response. This initiates the specific antibodies' synthesis in the spleen [11, 13, 14] and specific T-cells are formed in the thymus. Most of them are eliminated under the target antigen influence

expressed by the eye tissues itself, but some of them - gets back into the bloodstream and, accordingly, into the visual analyzer system [6, 9, 10].

Thus, because of the visual analyzer tissues' structure peculiarities, the eye antigens collide with the innate immune system. This encounter leads to the inevitable immune response development culminating in the specific immunoglobulins formation and sensitized lymphocytes that enter the bloodstream [11, 15, 16]. Consequently, there is a circulation not only of eye tissues' antigens, but also of collision products with the innate immune system.

In this regard, it is legitimate to assume that because of visual analyzer tissues' structure some features, eye antigens' certain amount encounters the innate immune system. As a result, immunoglobulins and leukocytes specifically sensitized to the eye tissues and, among them, to the visual analyzer tissues', inevitably appear in the circulation. Because immune responses are essential defense elements against foreignness and inflammation, the eye has developed distinct mechanisms that provide an immune response to avascular tissues' injury to the eye. It is now known that injury and/or pathology in the eye's avascular regions triggers an immune system response that culminates in fibrosis that impairs vision [17, 18, 19].

Our early studies have shown that in the blood of practically healthy person (PHP), patients with glaucoma and keratitis circulates sensitized to the nerve, trabecular and lens tissues' antigens leukocytes. Their number clearly correlates with the pathology presence and its severity expression [20, 21, 22, 23, 24]. We explained this finding with the constantly occurring in almost all organs and tissues natural regeneration processes.

Since primary open-angle glaucoma (POAG) belongs to neurodegenerative eye diseases [10, 25, 26], we investigated the PHP and POAG patients' circulating leucocytes sensitization degree to optic nerve (ON) and optic disc (OD) tissue antigens. Moreover, the study results showed the presence in the PHP and POUG patients' peripheral blood leukocytes specifically responding *in vitro* to ON and OD tissue antigens [23]. As a result, the question arose about the PHP' peripheral blood leukocytes sensitization to other tissue antigens of the visual analyzer.

Purpose of the Study: The purpose of this investigation was to determine *in vitro* the practically healthy young persons' circulating leukocytes' sensitization degree to visual analyzer tissue antigens.

II. MATERIALS AND METHODS

120 practically healthy volunteer students (PHS) of the M. Garryev State Medical University of Turkmenistan aged 18 to 25 years without vision problems were examined. All of them underwent a standard ophthalmologic examination at the International Eye Disease Treatment Center of Turkmenistan. Besides the peripheral blood leukocytes' sensitization degree to optic nerve's tissue antigen (ONTA), optic disc's (ODTA) and retina's (RTA) tissue antigens were determined.

The material for the antigens was obtained at males aged 18 to 22 years autopsies who died from accidental injury. The leukocytes' sensitization degree to tissue antigen (TA) was determined in a modified leukocyte's migration inhibition reaction (LMIR) [27]. Antigens were used as leucocytes' migration inducers and they were prepared by water-salt extraction method following the recommendations [28]. Antigens were dosed according to protein concentration, which was determined by the Lowry method [29]. The protein concentration in the antigens was at least 20 μg/mL. The antigens (1.0 mL) were stored in disposable microtubes in a freezer at -20 °C. All of TA were melted once before the study.

During the study, the 0.05 mL of antigens was added into the incubation medium of chambers with capillaries. An equal amount of 0.9% sodium chloride solution was added to the control chamber. The leukocytes' number that migrated into the control chamber (without antigens) was taken as 100% and on relation to this, the leukocyte's migration index (LMI) was calculated. The study design is presented in Fig. 1.

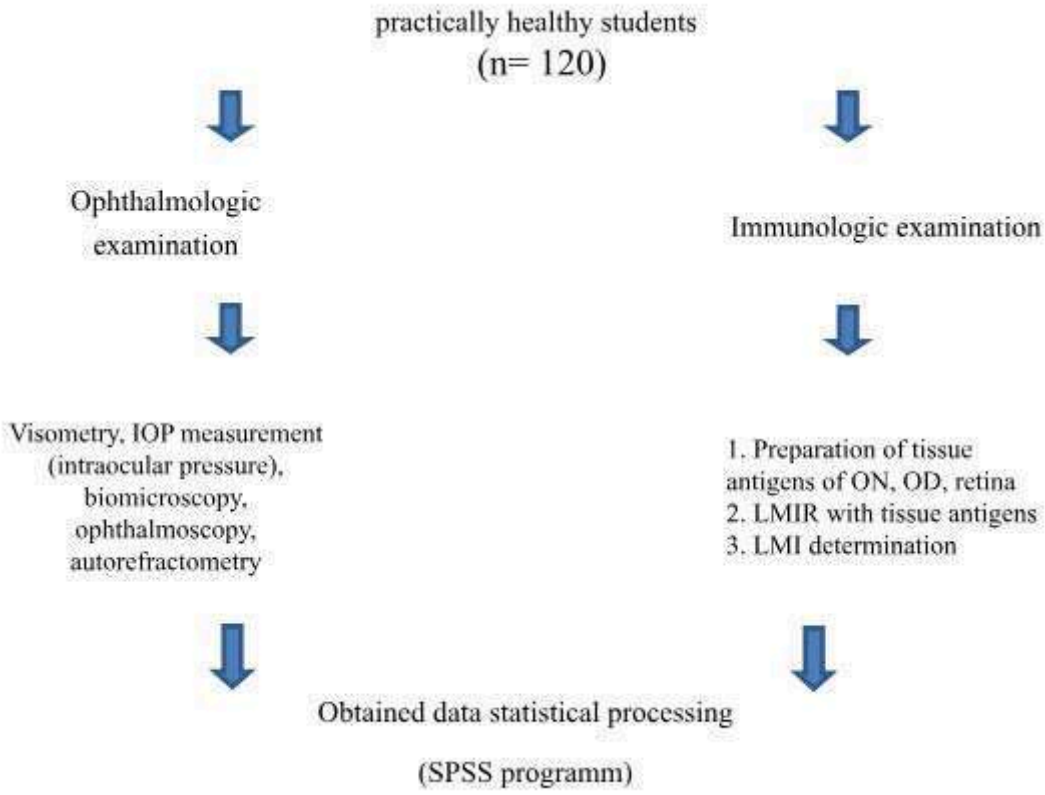

Figure 1: Design of Investigation

Ethics Approval

Approval was obtained from the local ethics committee (M. Garryyev State Medical University of Turkmenistan). The study was conducted in compliance with the ethical standards of the responsible institution on human subjects as well as with the Helsinki Declaration.

Study Results and their Discussion

Ophthalmologic examination showed that despite the absence of visual impairment complaints, it was not so of the all subjects (Fig. 2).

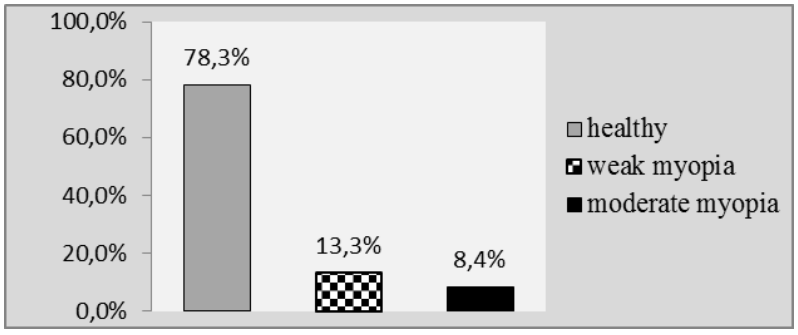

Figure 2: Visual Acuity Indices' Structure in PHS (%)

As can be seen on the diagram, visual acuity corresponding to the norm was detected only in 94 out of 120 PHSs (78.3%). Weak myopia was detected in 13.3% of PHSs and moderate myopia in 8.4%. In other words, in a quarter of the PHS cases there was hidden, undiagnosed myopia.

Immunologic examination showed that on the whole group all antigens - ONTA, ODTA, RTA *in vitro* modulates the PHS' peripheral blood leukocytes' migration activity, i.e., both stimulate and inhibit the leukocytes' migration from the glass capillary. This is evidenced by the fluctuations in the LMI values. The LMI value in

the ONTA's presence ranges from 34 to 156, in the ODTA - from 29.3 to 121 and RTA - from 46 to 160. The LMI average values depending on antigens are presented in the table (Table 1).

Table 1: LMI Value Depending on the Antigen Type

Group	Tissues antigens		
	ONTA	ODTA	RTA
PHS	76,4 ±4,9	79,4 ± 5,0	50,8 ± 3,8

It turned out that the LMI value in the TA presence depends on visual acuity (Table 2).

Table 2: LMI Value Depending on Students' Visual Acuity

Group	Tissues antigens		
	ONTA	ODTA	RTA
Common (n=120)	76,4 ±4,9	79,4 ± 5,0 t2,	50,8 ± 3,8
Healthy (n=94)	47,3 ±4,9 *	64,3 ± 5,0*	58,6 ± 3,8
Weak myopia (n=16)	81,3 ± 7,2**	81,3 ± 5,1**	46,6±3,1
Moderate myopia (n=10)	53,2 ± 6,7	98,3 ± 8,9 **	40,6 ± 5,1 *

*Notes: * - p<0.05, ** - p<0.01*

From the table's data, we can see that in the group of students with normal vision the LMI value in the ONTA and ODTA presence are the minimal. Since the LMI value is below 100, the obtained results show, first of all, about peripheral blood leukocytes' migration inhibition *in vitro* in the visual analyzer' tissue antigens presence.

Secondly, obtained results show about the leukocytes presence specifically responding to these tissue antigens in the blood circulation of healthy young people, i.e. sensitized to them.

In the group of students with myopia the LMI value in the ONTA and ODTA presence is significantly increased (p<0.01), but in the RTA presence is slightly lower compared to the healthy students' group (p>0.05).

Differences in the LMI value depending on the tissue antigen type are illustrated by the diagram (Fig. 3), which clearly shows that with increasing myopia's severity the blood leukocytes' sensitization degree to the ONTA increases.

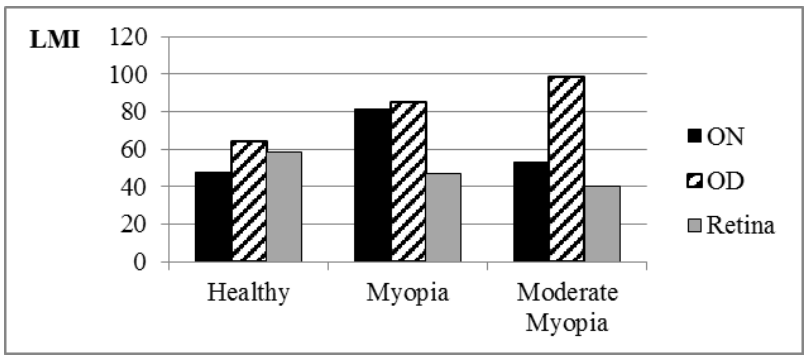

Fig. 3: LMI Values Depending on the Antigen and Vision Type

At the same time, the leukocyte response to retinal antigen *in vitro* progressively decreases and at the myopia's average degree the difference becomes reliable in relation to healthy individuals (p<0.05). Immune response to ON antigen is significantly increased in myopia (p<0.05), but decreases in relation to the students' group with myopia (p<0.05), but practically does not differ from the control level (p>0.05). The increase in the LMI value in the ONTA and ODTA presence can be explained, the decrease in the LMI value in the presence of RTA is difficult to explain. Previously, we found that the increase LMI value in the presence of tissue antigens *in vitro*

indicates the autoimmune attack development on the tissue *in vivo*, while the LMI value decrease, on the contrary, indicates the degenerative-sclerotic process development in the tissue [45]. In our opinion, the LMI value increasing in the RTA presence in myopia indicates the development of an inflammatory process in the tissue, whereas a LMI decreasing on increasing myopia's severity indicates the degenerative-sclerotic process development in the retina. It is even more difficult to explain the absence of positive correlation between the LMI value in the RTA, ONTA and ODTA presence (Table 3).

Table 3: Correlation Analysis Results (r)

Pirson's Correlation (r)	RTA	ODTA	ONTA
RTA	1	-,625	-,815
ODTA	-,625	1	,962
ONTA	-,815	,962	1

As it can be seen from the table, the LMI value in the RTA presence is inversely correlated with ONTA (r=,815) and ODTA LMI (r=-,625), while the ONTA and ODTA LMI values are connected by a high direct correlation (r=,962).

III. CONCLUSION

The life of an organism, the work of its various systems, organs, cells, the diversity of its reactions to external influences are accompanied by the old structures replacement with new ones. The renewal process takes place at all tissues organization levels - organ, cellular, molecular. That is, we are talking about the constantly running regeneration process in the body. Regeneration is the material basis for the adaptation and compensation processes to disturbed functions. Control over all processes of organism renewal is carried out by the immunobiologic surveillance system (IBSS) [30, 31, 32]. As a result, eye's many areas have evolved mechanisms to deliver immune cells to dysgenesis sites, injury, or in response to many age-related pathologies [14]. Although the immune reactions' goal is reparative or protective, cytokines secreted by immune cells impair vision acuity by causing inflammation and fibrosis [33, 34, 35]. It is possible that RTA plays a role as a target antigen, that inhibiting the immune response and therefore preventing the autoagression' development toward the ON and OND tissue antigens.

Thus, the results of our studies have shown that leucocytes, specifically sensitized to visual analyzer tissues' antigens - optic nerve, optic nerve disc and retina – circulates in the healthy persons' peripheral blood. It is possible, the LMI value in the RTA presence can be used as an early immunologic marker of myopia development. In our opinion, the negative correlation between the RTA, ONTA and ODTA LMI suggests that the RTA is a target antigen protecting the ON and OD from autoaggression. Studies in this direction seem to us promising, shedding light on the immune system nature involvement in the visual analyzer pathology development.

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Conflict of Interest

None to declare.

Informed Consent

Informed consent was obtained.

Author Contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Data Availability

The authors declare that data supporting findings of this study are available within the article.

Abbreviations

OD: optic disc;

PHP: practically healthy person;

POAG: primary open-angle glaucoma;

ON: optic nerve;

PHS: practically healthy students;

ONTA: optic nerve's tissue antigen;

ODTA: optic disc's tissue antigen;

RTA: retina's tissue antigen;

TA: tissue antigen;

LMIR: leukocyte's migration inhibition reaction;
LMI: leukocyte's migration index;

IOP: intraocular pressure;

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