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THE STABILITY OF GLUCOSE AND TRIGLYCERIDE ANALYSIS IN GEL TUBES AT 2–8 °C

Abstract

Introduction: Studies have shown that there are important, significant relationships between the values of different analytes with different physical variables such as temperature, measurement time, and centrifugation time. In this paper, the relationship that may exist between the concentration values of two analytes such as blood glucose and triglycerides with the storage temperature of the samples has been studied.

This study aimed to determine the analyte stability of venous blood samples in serum gel tubes stored at 2–8 °C.

Methods: 30 healthy adult volunteers take part in the study. Blood was collected in tubes with gel (Clot activator). All samples were allowed to clot at room temperature for 30 min. They were centrifuged CAPP CENTRIFUGE at 3500 RPM and 2 analytes were analyzed: Triglycerides and Fasting Blood Glucose. These values were determined as control values. Serums were stored at 2–8 °C. Measurements were repeated after 1 week.

Results: 18 men and 12 women participated in the study. Triglycerides control values range from 54–149 mg/dl average (86.58mg/dL).

Fasting blood glucose values were in the range of 77–91.8 mg/dl, with an average value (of 80.23 mg/dL).

After keeping the serum at a temperature of 2–8 °C for 1 week, the following results were obtained:
- Triglyceride values ranged from 60.3–117 mg/dl, mean of value (92.25 mg/dl);
- Glucose values ranged from 53–124.4mg/dl on average (83.7 mg/dL).

Conclusions: There is a statistically significant relationship between the storage temperature of the sample and the concentration of the Triglyceride analyte (p – 0.00), while for the comparison of Glucose control and Glucose values after one week, they are not statistically significant (p = 0.2).

Keywords: Gel tube, Triglyceride, fasting blood glucose, temperature.

Introduction

Laboratory examinations have an important role in clinical diagnoses. This has made some tests part of the check-up routine. Tests such as fats and blood sugar have a role both in the diagnosis and in the prognosis of a certain pathology, so often for these tests, there is a need to repeat the measurements.

Most biochemical tests are performed on serum samples, that is, in gel tubes (Clot activator) Some studies show that these tubes maintain the stability of the values without the need to divide the samples into other tubes, but there are also studies that prove the opposite. The purpose of this study is precisely to see the stability of the values of the analyte *Glycemia* and *Triglyceride* in the tubes with gel but exposed to the temperature variable

2. Materials and methods

The study involved 30 (thirty) volunteers, who were healthy adults, not anemic, and they were not on an anticoagulant therapy. Twelve female and 18 men volunteers between the age of 19 and 22 took part of this study. Five milliliters of venous blood were drown from each volunteer using a vacuum machine and gel tubes (Clot activator)

2.1 Collection and processing of samples

Each volunteer underwent a phlebotomy procedure for blood collection. Blood was collected from forearm veins using a 21G vacuum system. All samples were identified and homogenized at least five times. Each sample was allowed to be set for 30 minutes at 18–25 ºC. All tubes were centrifuged at 1500g/3500 RPM for 10 minutes at 18–25 ºC.

2.2 Analysis of samples

All tubes were evaluated for hemolysis, icterus, and lipemia. The CYANSMART device (ELITEK) was used to analyze the samples. Triglyceride and glucose reagents were kept at a temperature of 18––25 ºC for 15–20 minutes. After each test, a calibration and control procedure was performed.

The principle of the Glycemic measurement method is: **Glucose oxidase**

☞**METHOD & PRINCIPLE** [5]
Enzymatic / PAP - End Point.

$$Glucose + O_2 \xrightarrow{\text{Glucose oxidase}} Gluconic\ acid + H_2O_2$$

$$2H_2O_2 + Phenol + 4\text{-}Aminoantipyrine \xrightarrow{\text{Peroxidase}} Quinoneimine + 4H_2O$$
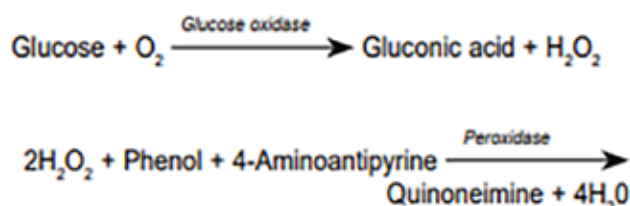
Figure 1. The principle of the glucose method

Manual procedure
- Wavelength 505 nm;
- Optical path: 1cm;
- Sample/ Reagent ratio: 1:100;
- Temperature: 37 ºC

Read against reagent blank.

	Blank	Calibration	Test
Reagent R	1000 μl	1000 μl	1000μl
Distilet water	10 μl	–	
Standart/ Calibrator	–	10 μl	–
Sample	–	–	10 μl

Mix and read the absorbances (A) after an incubacion of 10 minutes

METHOD [3]
Enzymatic-colorimetric. End point.

PRINCIPLE [3]
Enzymatic determination of triglycerides according to the following reactions :

$$Triglycerides + H_2O \xrightarrow{\text{Lipoprotein Lipase}} Glycerol + Fatty\ acids$$

$$Glycerol + ATP \xrightarrow{\text{Glycerol kinase}} Glycerol\text{-}3\text{-}Phosphate + ADP$$

$$Glycerol\text{-}3\text{-}Phosphate + O_2 \xrightarrow{\text{GPO}} DHA\text{-}P + H_2O_2$$

$$H_2O_2 + 4\text{-}AAP + p\text{-}Chlorophenol \xrightarrow{\text{Peroxidase}} Quinoneimine$$
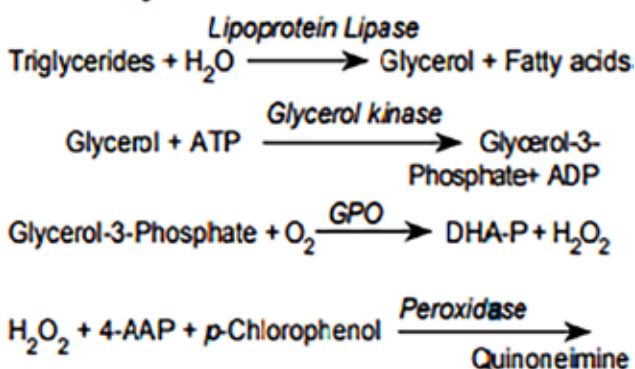
GPO = Glycerol-3-phosphate oxidase
DHA-P = Dihydroxyacetone-P
4-AAP = Amino-4-antipyrine

Figure 2. The principle of the Triglicerid method

The principle of the method of measuring triglycerides vs Triglyceride Oxidase. Both spectrophotometric methods are END points.

Manual procedure

- Wavelength 505 nm;
- Optical path: 1cm;
- Sample/ Reagent ratio: 1:100;
- Temperature: 37 oC;

Read against reagent blank.

	Blank	Calibration	Test
Reagent R	1000 μl	1000 μl	1000μl
Distilet water	10 μl	–	

Standart/ Calibrator	–	10 μl	–
Sample	–	–	10 μl

Mix and read the absorbances (A) after an incubacion of 10 minutes

All samples were measured at the beginning and their values were considered control values. Afterward, the gel tubes were stored in a refrigerator at a temperature of 2–8 oC. After 1 week, these tubes were left at room temperature for 10–15 min, re-centrifuged and re-measured, maintaining the same calibration and control conditions.

Figure 3. Semi-automatic biochemistry analyzer CYANSmart

3. Results of the study

All measurement values were entered into the SPSS version 21 program and processed. The statistical analysis showed that there is a statistically significant relationship between the concentrations of triglycerides and the temperature variable.

Table 1. – Indicates the statistical relationship between Tg concentrations. According to the statistical processing, we have a statistically significant relationship (P = 0000) between the concentration of Tg control and the concentration of Tg after 1 week at a temperature of 2–8 oC

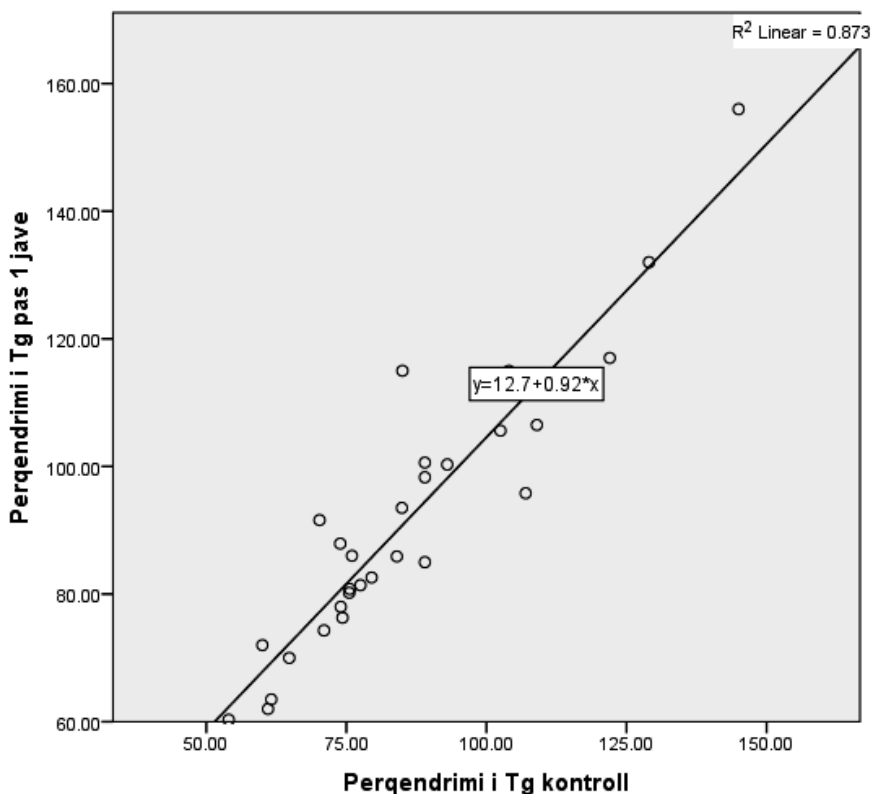| Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	The concentration of Tg control Tg concentration after 1 week	–5.67000	7.87594	1.43794	–8.61092	–2.72908	–3.943	29	0.000

Figure1. Shows the scatter blot of the relationship between the Tg concentration in a 1-week time difference at a temperature of 2–8 ◦C. As can be seen from the graph obtained from SPSS VERSION21, there is a linear distribution of values, which shows that there is a positive statistical relationship between the concentration of triglyceride and the temperature variable

Additionally, it was demonstrated that there is no correlation between glucose concentrations and temperature in the region 2–8 ˚C. The linearity is **R = 0.873** and the equation obtained from excel is **y = 12.7 + 0.92 x**. It was demonstrated that there is no correlation between glucose concentrations and temperature in the region 2–8 ˚C.

Table 2. – Shows the statistical relationship between fasting glucose concentrations. According to the statistical analysis, there is no statistically significant relationship (P=0.2) between the control glucose concentration and the glucose concentration after 1-week storage at a temperature of 2–8 ◦C

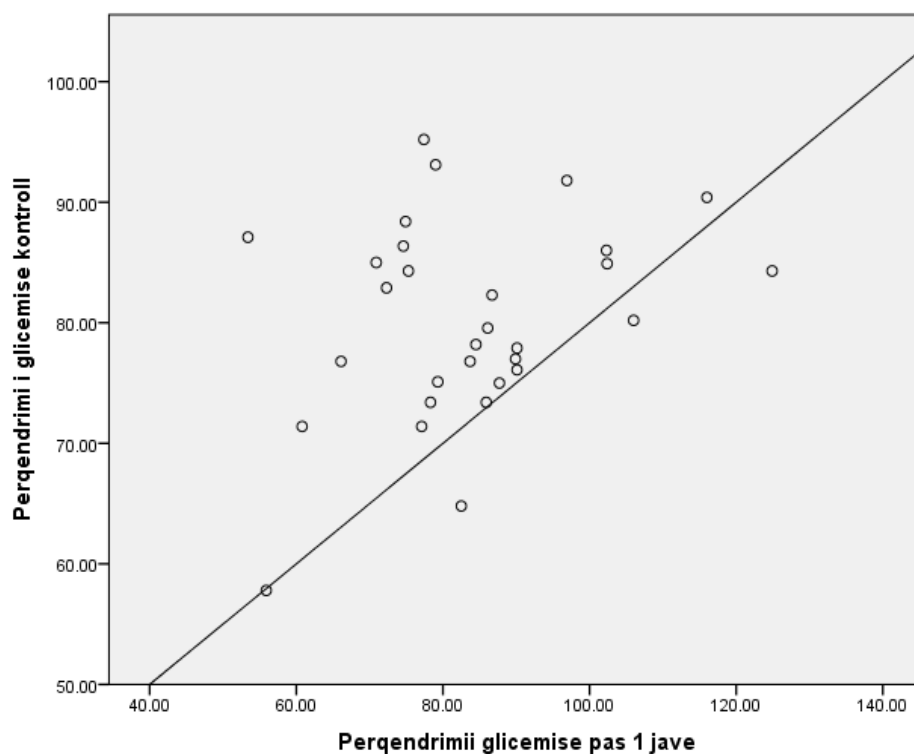| **Paired Samples Test**									
		Paired Differences					**t**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	**Upper**			
Pair 1	**Glucose concentration after 1 week – control glucose concentration**	3.46933	15.71995	2.87006	–2.40059	9.33926	1.209	29	0.237

Figure. 2 shows the scatter blot of the relationship between the end of Glycemia in a time difference of 1 week at a temperature of 2−8 °C. As can be seen from the graph obtained from SPSS VERSION21, there is a non-linear distribution of values, which shows that there is no positive statistical relationship between the concentration of glucose and the temperature variable, so the concentration changes. This means that the gel tube does not adequately maintain the glucose concentration

4. Discussions

From the results of the work, different interpretations and opinions arise which will be analyzed in the following works for the measurement of analytes. The results of the work showed the statistical relationship that existed between the temperature variable and Triglycerides, and the lack of a statistically significant relationship between the glucose concentration and the temperature variable, which makes us analyze what would happen if maintaining the same measurement procedures but extending The time the samples stay in the temperature range of 2−8 ºC.

It is known that the gel tubes can maintain the stability of the analytes for up to a week, at a temperature of 2−8 (various studies), and in the case of the study, the gel preserved the triglyceride value while the glucose value did not, and this is related to the effect of glycolysis because this is a basic process of cellular energy production, a process which is stimulated by the temperature factor. the effect of the decrease in glucose concentration as a result of this phenomenon is slower as the temperature decreases. in this study, it was observed that the separating gel of the tube does not inhibit the process of glycolysis and as a result, the glycemic values changed. The change in blood glucose values may also have come as a result of the presence of blood elements in the serum. (number of leukocytes always interfere in this avoidance of glucose concentration values).

The second discussion is related to the use of a tube with sodium fluoride, to evaluate if, under the same analysis conditions, these obtained statistical relationships are preserved, which will provide valuable information regarding the obtained values (of blood, serum) and analytes).

Acknowledgement

This study was conducted in the Clinical Biochemistry Laboratory at Aldent University. A special thanks goes to this institution as well as to my colleagues. For the help, support and the review carried out.

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IDENTIFICATION OF STREPTOCOCCUS PYOGENIUS IN THROAT CULTURES OF PATIENTS WITH THROAT PAIN

Abstract

Background: Streptococcus are gram-positive bacteria that cause various respiratory and systemic pathologies. They are the cause of upper respiratory problems which are usually manifested with clinical signs such as Sore throat, temperature, cough, and difficulty in breathing.

Materials and Methods: To carry out this study, biological samples were taken from the throat of patients who referred symptoms. These samples were subjected to laboratory microbiological examination of the throat culture on the Agar-blood medium. Then, to identify the colonies, differential biochemical tests were performed such as Gram stain, Bacitracin test, and ASO test.

Results: 200 patients aged from 4 to 79 years participated in the study.

After culture in Blood Agar and biochemical differential tests, the following results were obtained:

• 83 cultures (41.5%) were positive for pathogens of the Micrococcacea family, of which 44 males (53.01%) and 39 females (46.99%).

• 50 patients (60.24%) tested positive for ß hemolytic streptococcus type A (streptococcus pyogenus). Average age 34.18 years. All patients had high ASO titers.

Conclusions: This study found an increase in cases of respiratory infections with pyogenic streptococcus in the period January-March in different age groups. The high titer of ASO testifies to the presence of systemic infections in these patients

Keywords: streptococcus pyogenic, throat culture, gram stain.

Introduction

Bacteria of the genus Streptococcus are gram-positive heads typically located in the form of a chain (2–30 cells), they are catalase-negative and have a fermentative metabolism (they produce acid from the fermentation of carbohydrates).

Blood Agar (sheep) is preferred for their growth, which provides important information on the degree of hemolysis. The colonies are small, ranging from the exact size to 2 mm in diameter, and they may be surrounded by an area where erythrocytes suspended in agar are hemolyzed. When the area is clean, this condition is called β-hemolysis. Streptococci grow better in aerobic or anaerobic conditions, so they are (facultative).

When the area is cloudy with a green agar stain, it is called α-hemolysis. The type of hemolysis and some biochemical reactions are important for

differential diagnoses and as an indication of what subsequent taxonomic tests should be performed. Streptococci are metabolically active for various carbohydrates, proteins and amino acids. Fermentation of glucose produces mainly lactic acid.

This genus includes more than 100 species and their classification is done according to 3 classification schemes.

- antigenic properties (Lancefield Classification;
- Hemolytic models (complete beta hemolysis, partial alpha hemolysis, without gamma hemolysis;
- biochemical properties.

For convenience in practice, streptococci are divided into 2 groups:

- Beta hemolytic streptococci that are classified by the Lancefiel group;
- Hemolytic alpha and gamma streptococci that are classified according to biochemical tests.

Rebecca Lancefield discovered the serological classification scheme in 1933. This scheme is used today for a few species of Streptococcus. According to this classification, streptococci are divided into groups A-U where the most popular are groups A-G and from this group, group A or pyogenic streptococcus is the most important.

Group A Streptococci (Streptococcus pyogenes)

Group A streptococcus is the most common cause of bacterial pharyngitis. Group A streptococci (GAS) usually appear in purulent lesions or in fluid cultures as spherical or ovoid cells in chains of short to medium length (4–10 cells).

Culture on Blood Agar. On blood agar plates, colonies are usually compact, small, and surrounded by a 2 to 3-mm zone of β-hemolysis, which is easily seen and clearly demarcated. β-hemolysis is caused by one of two hemolysins, streptolysin S and the oxygen-labile streptolysin O, both of which are produced by most strains of group A. Strains lacking streptolysin S are β-hemolytic only under anaerobic conditions because streptolysin O the remainder is inactive in the presence of oxygen. This feature is of practical importance, because such strains would be absent in clinical laboratories if cultures were incubated only aerobically.

The virulence of the pyogenic streptococcus is related to the antigenic structure and the exotoxins released by it.

Antigenic structure

1. The cell wall is built on a peptidoglycan layer that provides rigidity. Also, part of the structure is the M protein and lipoteichoic acid (LTA) that are attached to the cell wall, Group A Streptococci are divided into more than 100 serotypes based on antigenic differences in the M protein.

2. Protein M has a chemical structure similar to myosin. Due to its positioning, this protein acquires an immunogenic role and serves as a binding domain for other molecules such as Fibrinogen, serum H protein or Immunoglobulins.

3. Other molecular structures that affect pathogenicity are also an **F protein and fibronectin-binding** LTA, both on the surface of streptococcus that, due to binding to the Fc part of Ig, affect optionism.

4. Hyaluronic acid in the capsule is an important element for phagocytosis.

The antigenic structure is important for the pathogenesis of the infection.

1.1 Exotoxins

Exotoxins are substances related to the virulence as well as the clinical manifestations of this bacterium. The most important toxins are:

1. Streptolysin O

Streptolysin O is a pore-forming cytotoxin that lyses leukocytes, tissue cells, and platelets. This toxin is resistant to oxygen. Streptolysin O is antigenic, and the number of antibodies against it is the basis of a serological test called anti-streptolysin O (ASO).

2. Super antigenic streptococcal toxins

Over many decades, these toxins have been assigned a variety of names related to their association with scarlet fever (erythrogenic toxins) and streptococcal toxic shock (streptococcal pyrogenic exotoxins [Spe]).

3. Other extracellular products

Most GAS strains produce a variety of other extracellular products including streptokinase, hyaluronidase, nucleases, and C5a peptidase. Peptidase is an enzyme that destroys the complement protein C5a, the main factor that attracts phagocytes to sites of complement deposition. Other enzymes play a role in tissue damage. Some of them have also been used as serological tests, eg Streptokinase.

1.2 Group a Streptococcal Infections:

Group A streptococcus is responsible for several pathologies:

Noninvasive pathology

- Pharyngitis;
- Impetigo;
- Cellulitis.

Invasive dieses:

- septicemia;
- bacteremia;
- Streptococcal Toxic Shock Syndrome.

Non-suppurative sequeiae:

- Glomerulonephritis;
- Rheumatic Fever.

This study aims to identify streptococcus as the primary cause of pharyngitis in patients of different ages

2. Materials and methods

For the realization of this study, throat cultures were performed on patients of different age groups who were referred to the same clinic:

- disorders of the respiratory tract;
- cough with sputum;
- sore throat;
- difficulty in swallowing;
- temperature;
- shoulder pain.

In this time period, January-March 2023, 200 throat cultures were performed.

2.1 Laboratory sample

Sampling was done with a sterile swab from the back of the tonsils or posterior larynx. Patients must be healthy and not have taken antibiotics or other medications. Oral hygiene should also be avoided.

2.2 Culture on Blood Agar

Throat cultures were collected on Blood Agar, and incubated in a 37 ºC thermostat for 24 hours and the morphology of the colonies was studied (small, grey colonies with the presence of beta hemolysis).

Figure 1. View of the field with culture of streptococcus

After culture in blood agar, differential and biochemical tests were performed to identify the group.

2.3 Bacitracin test

This test is based on the sensitivity of streptococcus group A to Bacitracin. The principle of this test consists in placing an antibiotic disk saturated with bacitracin, which after 24 hours of incubation in a thermostat at a temperature of 37 will inhibit the growth of group A streptococcus only.
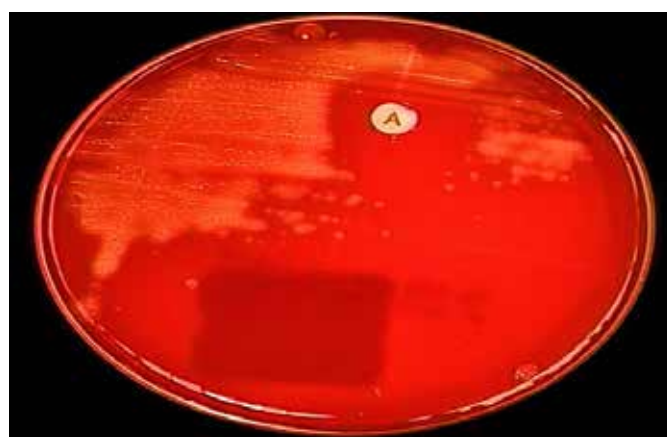

Figure 2. Bacitracin Sensitiviti Test

After incubation, the developed colonies were identified and differentiated. Out of 200 throat

cultures, 83 (41.5%) of them were positive for the coccus genus.

The differential diagnosis within the type of streptococci was carried out with biochemical tests such as:

- bacitracin test (beta-hemolytic streptococcus type A);
- optokinetic test (streptococcus pneumonia).

After performing this test, 50 patients (60.24%) were found to have ß-hemolytic streptococcus type A (streptococcus pyogenus).

For the diagnosis of post streptococcal consequences as evidence of a previous infection, serological tests such as the ASO test are used.

This test consists of the identification of antibodies created by the organism against Streptolysins O. This test is qualitative, but for patients who have a positive result, dilutions of the serums are made, accurately determining the concentration of the antibodies. In this case, the test takes the nature of a quantitative test and is important in diagnosis.

These antibodies show the immune response following a repeated infection and for this reason they are of the IgG type.
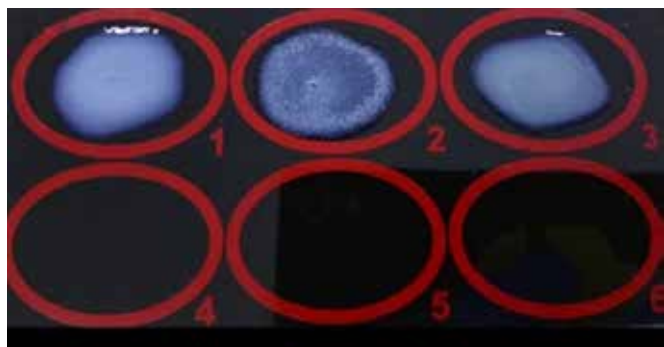

Figure 3. The ASO test

The high titer of IgG indicates an existing systemic infection that does not have a specific localization, which brings difficulties in the media treatment of these patients, both in the type of antibiotic and in the duration of treatment, thus negatively affecting the quality of life of the patient.

For patients who tested positive for Streptococcus ß hemolytic type A, venous blood was taken by venipunctures in gel tubes (Clot activator) with a 21G vacuum system and centrifuged in the CAPP CENTRIFUGE centrifuge at 3500 RPM for 15 minutes. The serum was tested for the presence or absence of IgG antibodies (qualitative test). Serums that were positive with IgG were diluted and their titer was measured, which turned out to be high. This shows that we have the presence of systemic infections.

4. Conclusions

Streptococcus pyogenius is one of the most frequent causes of upper respiratory tract infections, mainly pharyngitis in children aged 5 to 15 years. According to this study, a touch of patients in the age group older than 15 years is observed, which shows a large spread of these pathogens for various reasons such as: poorly processed foods, poor hygiene.

The second discussion is related to the high titer of the ASO serological test observed in these patients. This test is a drop-down indicator to show that this infection is already systemic, so antibiotic treatment will be even more difficult.

The third discussion is related to antibiotic resistance, a current global problem. The treatment of infection should not be symptomatic and broad-spectrum antibiotics should be taken, but microbiological laboratory tests combined with antibiograms should be performed in order for the treatment to be as efficient as possible and to further avoid resistance to antibiotics.

The fourth discussion is related to the medical awareness of patients who should be more aware and not avoid routine laboratory examinations since the quality of their life depends on these simple tests.

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PECULIARITIES OF TREATMENT OF WOMEN IN A RETROSPECTIVE GROUP DURING MASSIVE OBSTETRIC HEMORRHAGE

Abstract. The article describes the analysis of the causes of massive obstetric hemorrhage, treatment features, possible errors made by conservative and surgical treatment. The main causes of massive obstetric hemorrhage were postpartum atony of the uterus, detachment of a normally located placenta and placenta previa. The amount of lost blood averaged $2{,}410.45 \pm 520.55$ ml. Mistakes made during the clinical examination, surgical, conservative treatment and organizational issues led to 5 cases of maternal mortality and a deterioration in the quality of life of a woman in the study group.

Keywords: massive obstetric bleeding, placenta detachment, uterine atony, infusion-transfusion therapy, total hysterectomy.

Introduction

Bleeding, the most dramatic complication of obstetric practice, remains one of the main causes of maternal mortality worldwide in the 21st century. According to the 2017 World Health Organization, bleeding accounted for 30.0% of the causes of maternal mortality, and in Uzbekistan for 2013–2015 years – 25.8% [9,10,14,19].

It is known that only 62–65% of deliveries through the natural birth canal are accompanied by physiological blood loss, 1/3 of patients lose from 500 to 1000 ml of blood, and in 3–8% of cases, the volume of blood loss exceeds 2% of the woman's body weight or more than 30% CBV is considered massive obstetric bleeding (MOB), requiring transfusion of red blood cell mass and often removal of the uterus [2,11].

The main causes of bleeding are violations of the processes of separation of the placenta and placenta, detachment of the normally located placenta, placenta previa, sepsis, obstetric embolism, traumatic injuries of the birth canal, uterine rupture, decreased contractile activity of the myometrium (uterine atony) and disorders in the blood coagulation system, most of them accompanied by massive obstetric bleeding [1,7,8,20].

In our republic, according to the National Committee for the Confidential Investigation of Maternal Mortality (MM), massive blood loss was treated inappropriately and in 34% of cases it was associated with a delay in the onset of surgical hemostasis and technical difficulties during hysterectomy [9].

Research objective: to evaluate the effectiveness of therapeutic measures for massive obstetric bleeding in a retrospective group.

Material and methods

Analysis and evaluation of treatment results for massive obstetric hemorrhage in the retrospective group was carried out from the period 2014 to 2017. The material was collected and analyzed on the basis of the perinatal center in the city of Urgench, studying the history of childbirth, clinical and laboratory

data, the appointment sheet and anesthesia card. Clinical and biochemical blood tests were studied, if necessary, hemostasiogram, urinalysis. The retrospective group included 178 pregnant women, women in childbirth and puerperas who underwent massive obstetric bleeding and total hysterectomy during labor and in the early postpartum period. The following methods were used to determine the amount of blood loss: visual; gravimetric – the operational material was weighed and the volume of blood loss was calculated using the Libov formula. An ultrasound examination of the fetus, abdominal cavity and, if necessary, computed tomography of the pelvic organs.

Results

During 4 years, from 2014 to 2017, 32,896 births occurred in the perinatal center in Urgench, and of these 178 cases ended in massive obstetric bleeding (MOB), which was 0.54%, and 5 were observed during this period (45, 4%) cases of maternal mortality from this pathology.

The concept of the term MOB is determined by the following criteria: it is blood loss of more than 150 ml / min, more than 50% of the CBV within 3 hours, more than 1500–2000 ml or the need for more than 10 doses of red blood cells within 24 hours, as well as a decrease in hematocrit by 10% in combination with hemodynamic disturbances (arterial hypotension) [2].

Of all 178 cases of MOB, 75 (42.1%) of bleeding occurred during pregnancy. Of these, against the background of detachment of a normally located placenta of mild and severe degree in 64 (35.9%) cases, placenta previa was 11 (6.1%). In the birth process and the earlier postpartum period, against the background of hypotension and atony of the uterus, 103 (57.8%) cases of MOB were observed, of which 44 (24.7%) cases were associated with cesarean section and its complication. Over the past decade in Uzbekistan, the average static rate of cesarean section surgery has reached 18.1%. According to WHO (2015), cases of surgical interventions during child-

birth have become more frequent and it has reached more than 30%, these data are based on the results of two studies in the field of population reproduction under the auspices of UNDP, UNFPA, WHO and the World Bank. However, it should be noted that the safe frequency of use of the Cesarean section should be no more than 10% [4].

Basically, MOB was found up to 30 years in 97 (88.9%). The average age of the pregnant women was 26.8 ± 2.3 years. Among pregnant women with IAC, housewives were –46.8%, employees –28.3%, workers –14.6%, students-6.4% and medical workers-3.6%. By nationality, patients with MOB were: Uzbeks – 71.5%, Russians – 13.7%, Korean women – 6.4%, other nationalities – 5.5%, i.e. predominantly pregnant women of local nationality. Among pregnant women with MOB, pre-pregnant women –23.3%, pre-pregnant women –76.6%, and premature births –28.5% and urgent births –71.4% were met, of all the births induced –12 cases (6.7%) due to preeclampsia of mild severity. Thus, MOB occurs at any fertile age, mainly during repeated pregnancy, and no connection with the profession has been found.

From 178, 63 (35.3%) patients had metabolic syndrome i.e. morbid obesity, body mass index was more than 32, which today is considered as one of the risk factors for bleeding. When analyzing the anamnestic data, it was revealed that 3 (1.6%) women had uterine fibroids, one woman had previously undergone myomectomy. 67 (37.6%) patients had a history of inflammatory diseases of the uterus and appendages, which also plays a role in subsequent incorrect placentation during pregnancy [10]. Almost every third patient had a history of endometrial curettage, and the average number of procedures was 1.5 ± 0.5. 13 (7.3%) women in the previous birth had bleeding, about which they received transfusion of donor blood components (er.massa). Three patients had antenatal fetal death in a previous pregnancy in the third trimester.

The volume of bleeding in the retrospective group, in which there are ordinary placenta of mild

and severe degree, in 64 (35.9%) cases averaged 1890.0 ± 150.0 0.05) and against the background of placenta previa in 11 (6, 1%) of patients, on average 2450.0 ± 200.0 (p> 0.05). The volume of blood loss was significantly greater and reached 5000.0 ml. In the birth process and the earlier postpartum period, against the background of hypotension and atony of the uterus, the average amount of blood loss was 2050.0 ± 120.0 (p> 0.05) in 103 (57.8%) cases.

Thus, speaking about the volume of blood loss, it should be said that it varies from 1550.0 to 5000.0 ml depending on obstetric pathology and averages 2410.45 ± 520.55 ml. Interoperative blood loss in the amount of 750 ± 110.0 (p> 0.05), ml, observed in a patient in whom cesarean section was initially performed and, when the operation was expanded to extirpation of the uterus, blood loss increased to an average of 1650.0 ± 150.0 (p> 0.05), the duration of the operation before total hysterectomy is 144.0 ± 15.0 min (p> 0.05).

All patients with an industrial operation to remove the uterus have low ocular amputation of the uterus (subtotal hysterectomy) – in 14 (7.8%); uterine extirpation (total hysterectomy) – in 164 (92.1%). Total hysterectomy with severe DIC in the stage of hypocoagulation is accompanied by ligation of the internal artery – in 68 (38.2%) cases, it should be noted that in 41 (23.0%) patients, an organ-preserving operation was performed at the beginning as "ligation of three main vessels" and "Hemostatic sutures on the uterus of B-Lynch", however, due to the lack of effect for a little more than 30 minutes, the volume of operation expanded to extirpation of the uterus. During the operation of hysterectomy, in 6 (3.3%) cases, removal was performed due to hemorrhage and necrosis of the ovaries and in 14 (7.8%) cases of some appendages. I want to note that you have 32 (17.9%) surgical interventions performed on time, 26 (14.6%) operative help started one hour late, 112 (62.9%) two, 7 (3.9%) for three and y1 (0.5%) for 5 hours because of the survival of the tactical and because of the attempt of organ-preserving surgery.

The clinical picture with MOB is due to the loss of blood as a circulating plasma volume. A decrease in hemoglobin level (below 60 g / l) occurs with blood loss> 35–40.0% of CBV and causes the development of tissue organ hypoxia. A decrease in the concentration of components of the blood coagulation system occurs with blood loss> 50% of the CBV, which leads to depletion of the hemostatic system, the development of DIC – syndrome, hemorrhagic shock, aggravation of the state of the puerpera and often fatal outcome.

The analysis in the retrospective group, out of 178 cases, in 5 (2.8%), pregnancy and childbirth ended in maternal mortality. When we analyzed these 5 cases, only 3 (60.0%) were registered with an obstetrician-gynecologist, but 2 (40.0%) were not registered in the primary care. Of the three registered, a somatic disease was established such as UTI (chronic pyelonephritis), hepatitis, acute respiratory viral infections, and moderate iron deficiency anemia.

The gestational age of 37–40 weeks was observed in 4 (80.0%) of the dead and 1 (20.0%) gestational age of 35 weeks, and she died from central placenta previa accompanied by MOB, hemorrhagic shock, DIC, and multiple organ failure incompatible with life. The pregnant woman was admitted to the hospital in an extremely serious condition, with blood loss of more than 2000.0 ml, and at the final stage of the operation, total hysterectomy died on the operating table. In the structure of maternal mortality, 2 (40.0%) had a detachment of a normally located placenta of a severe degree, 1 (20.0%) uterine rupture, and 1 (20.0%) atonic postpartum hemorrhage. It should be noted that patients who died from uterine rupture with a central placenta previa were not registered in the primary care, as both were abroad and they arrived at home after 34 weeks of gestation.

In the traditional group, 178 patients with MOB underwent intensive therapy: infusion – transfusion, plasma, blood transfusion with the correction of DIC – syndrome i.e. multicomponent correction.

An analysis of the volumes and qualitative composition of infusion and transfusion therapy in the treatment of MOB showed that the volume of crystalloid solutions (0.9% sodium chloride) averaged 3350.50 ± 1050.40 ml (from 2000 to 5000 ml), the volume of the hydroxyethyl starch solution (HES) 6% of reformed, hecaton averaged 1800.0 ± 150.0 ml. The composition of the infusion media should be balanced and close to that of the blood plasma, however, the parameters presented to the infusion media are not applicable to a 0.9% aqueous solution of sodium chloride. Studies have shown that due to a 1.5-fold excess of the chloride content in physiological saline, compared with blood plasma, massive volemic support for this medium leads to hyperchloremia associated with a twofold increase in mortality. In the case of adequate intensive care that was started on time (in the first 10–30 min), the outcome in hemorrhagic shock is usually favorable [2]. However, the main intensive care with crystalloids was started late by 55.4 ± 10.6 min and 2.5 times more than expected.

With MOB, the volume of bleeding is significant, and coagulation and anti-coagulation factors are rapidly consumed. When the volume of blood loss is more than 30–35% of the CBV, you should start the rapid administration of donor freshly frozen plasma (FFP) in a volume of at least 20 ml / kg of mass [6]. On average, FFP was transfused in volumes of 1650.17 ± 384.83 (p> 0.05) the first day, second day 950.12 ± 150.20 (p> 0.05), until the DIC syndrome was completely corrected. Due to organizational issues, sometimes expectant tactics, they were late by plasma transfusion for 87.5 ± 10.2 minutes.

Before and during the operation, 38 (21.34%) patients with MOB underwent full infusion therapy with up to 15 mg / kg body weight of tranexamic acid (hemotran), repeating every 6–8 hours until complete hemostasis, but in 96 (53, 9%) in patients the administration of this drug was carried out in an insufficient dose of 500 mg once a day, and in 44 (24.7%) they were not used at all due to the lack of this drug. As a means of normalizing the fibrinolysis system, tranexamic acid (hemotran) is used – a synthetic amino acid that competitively inhibits plasminogen; its effectiveness is 15–20 times higher than aminocaproic acid (17.18). The action of tranexamic acid is carried out by inhibiting the lysine-binding sites of plasminogen, so that this proenzyme does not turn into plasmin and cannot bind to fibrin. Tranexamic acid (hemotran) also inhibits the production of kinins and other active peptides, which provides an anti-allergic and anti-inflammatory effect of this drug [18]. When using this antifibrinolytic agent, there was no increased risk of thrombotic complications.

To achieve the maximum effect of tranexamic acid (hemotran), it is necessary to select the appropriate dose of the drug. This antifibrinolytic is administered immediately before an incision on the anterior abdominal wall at a dose of 10–15 mg / kg of body weight intravenously drop by drop on saline (20–30 ml). Unfortunately, this drug for unknown reasons in the retrospective group with MOB in 44 (24.7%) patients did not use either a therapeutic or a prophylactic dose [13].

In 87 (48.7%) patients in an insufficient dose of 100–150 thousand. used proteolysis inhibitors, mainly aprotinin (contracal). Although there is no evidence base for the use of aprotinin for the treatment of MOB, however, there are many articles reflecting the effectiveness of this drug in the treatment of DIC syndrome, inhibiting the fibrinolytic activity of the blood and inhibiting the effect of fibrinolysis, thereby preventing the progression of intravascular coagulation [8,14].

It should be noted that in this group of 13 (7.3%) patients rFVIIa (Coagil) was administered at a rate of 90 µg / kg, with the development of severe hypocoagulation refractory to therapy using FFP and fibrinolysis inhibitors (15). The volume of blood loss averaged 2354.4 ± 465.4 ml. After the administration of rFVIIa (Coagil), a significant decrease in the speed and volume of bleeding was noted in these patients, which allowed them to perform a total hysterectomy with ligation of the internal iliac artery.

When discussing blood transfusion, it should be noted that transfusion of red blood cells containing blood components helps to restore the globular volume with MOB. Recently, a large positive role has been played by the procedure of apparatus intraoperative reinfusion of autoerythrocytes, which allows minimizing the use of donor red blood cells, and in some cases completely eliminating them, preventing possible blood transfusion complications and improving the outcome of surgery for MOB [12].

In the study group, transfusion of donor erythrocyte mass was performed for all 178 patients with MOB. It should be noted that a complete, timely and sufficient transfusion was performed only for 34 (19.1%), and 144 (80.8%) patients underwent this procedure from 1 to 5 hours late, and in insufficient quantities. 2 (1.1%) had a post-transfusion complication that required intensive care, and one of them was transferred to the hemodialysis ward.

Conservative treatment of MOB, such as pelvic arterial embolization, stepwise, stepwise uterine devascularization and / or ligation of the hypogastric artery, has become a reliable and effective alternative to hysterectomy. Although further long-term and subsequent studies are nevertheless necessary, and these procedures, according to foreign researchers, do not worsen subsequent fertility and pregnancy outcomes, these operations were not performed by the patient in the studied traditional group [15,16].

Conclusion

Thus, analyzing the 178 history of childbirth accompanied by MOB, in the period from 2014 to 2017 in the regional perinatal center in the city of Urgench we came to the following conclusion:

1. The frequency of massive obstetric bleeding in the studied retrospective group was 0.54%, and in the structure of maternal mortality 45.4%.

2. The main causes of massive obstetric bleeding were postpartum atony of the uterus in 103 (57.8%), detachment of the normally located placenta in 64 (35.9%) and placenta previa in 10 (6.1%). The amount of lost blood averaged 2,410.45 ± 520.55 ml.

3. The mistakes made during the clinical examination, surgical, conservative treatment and organizational issues led to 5 cases of maternal mortality and a deterioration in the quality of life of a woman in the study group.

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EVALUATION OF CLLULAR AND CYTOKINE REACTIONS IN PATIENTS WITH CHRONIC PANCREATITIS DURING IMMUNOTHERAPY

Abstract. The article provides data on the study of cellular parameters of the immune status and cytokine profile in 36 patients with chronic pancreatitis (CP). As a control, 30 apparently healthy individuals who had no pathologies from the gastrointestinal tract were selected. In patients with CP, profound suppression of the main pool of T (CD3) lymphocytes and its subpopulations, and of the interleukin profile were revealed. The use of the immunopreparation Thymoptinum (dose 0.8– – 1.0 mg per course of therapy) in combination with traditional treatment in patients with CP led to the normalization of the parameters of cellular immunity and stabilization of the interleukin profile.

Keywords: chronic pancreatitis, T– and B–links of immunity, cellular immunity, status, Thymoptinum, immunocorrection, interleukins.

It has now been established that in everyday life there are a number of unfavorable factors, which include shifts in the external environment, food technology, lifestyle and the spread of "Western nutrition", which led to an increase in pancreatic pathologies (PZh). Over the past 40 years, a tendency towards a steady increase in the incidence of chronic pancreatitis (CP) has been demonstrated by more than 2 times throughout the world [1–4].

CP in terms of prevalence, increased incidence and the cause of disability is an urgent problem of modern medicine. In the structure of diseases of the digestive system [3–6].

CP is 8–10%, and in general clinical practice – 0.2–0.6% and is the cause of temporary disability, high mortality in patients of the most working age [1, 7].

Disorders in the immune system can lead to inflammation in the pancreas. It can be both immuno–allergic reactions and the response of the organism of CP patients to microorganisms of bacterial nature. The last 20 years have been marked by the growth of research on disorders of the immune and cytokine status in diseases of the pancreas [1–8].

Purpose of the study: To study the cellular and cytokine parameters of the immune system and conduct immunocorrective treatment in patients with CP.

Materials and methods. 36 patients were examined (33–65 ages) with a diagnosis of CP. The diagnosis was carried out on the basis of complaints, medical history, and objective laboratory tests, instrumental data: ultrasound, fibrogastroduodenoscopy, survey radiography of abdominal organs. The control group consisted of donors from 30 healthy subjects (25–55 ages).

The parameters of cellular immunity (T–lymphocytes and a subpopulation, B–lymphocytes) were identified using monoclonal antibodies (LLC "Sorbent Service", Russia).

Quantification of levels TNF–a, IL-6, IL-4 in serum performed using reagents set ProCon (LLC "Protein contour", St. Petersburg, Russia) by ELISA. Immunotherapy was carried out in 15 patients.

Thymoptinum (Uzbekistan) was used as an Immunological drug. 0.8–1.2 mg per treatment (dose 100 mg/day for 8–12 days). The indicators of immunity was studied twice: before – and after 1 month after treatment).

Results and discussion. In patients with CP found immunodeficiency cell component: 0.7–times whatever suppression of the total lymphocyte pool – T(CD3) – 35.3 ± 2.6% as compared with the control group – 52.4 ± 1.8% ($p < 0.001$); 0.8–fold decrease in the absolute number of T (CD3) –cells ($p < 0.05$).

Also determined the oppression subpopulations of T–lymphocytes, have the helper–suppressor function – Th(CD4) – 29.5 ± 1.1% ($p < 0.001$) and 341.8 ± ± 32.1 cells/1 mcl blood ($p < 0.001$) (control in 36.5% ± 0.7 and 616.4 ± 44.3 cells/1 mcl of blood, respectively), the contents of Ts(CD8) – 13.8 ± 1.4% ($p < 0.05$) and 127.3 ± 9.8 cells/1 mcl blood ($p < 0.01$).

On the side of B (CD19)–cell link, opposite, the tendency to increase as the relative parameter – 20.6 ± ± 2.3% ($p < 0.05$), which was 1.4 times higher than those of the control group values, such and totally – 1.7–fold increasing – 385.8 ± 33.4 cells/1 mcl of blood (in the control – 230.1 ± 26.7 cells /1 mcl of blood).

Analysis of the spectrum of cytokines has shown that in patients with CP during the aggravations markedly increases the parameters of pro–inflammatory cytokines: TNF–α up to 202.6 ± 22.3 pg/ml (normal – 24.5 ± 5.1 pg/ml, $p < 0.001$) and IL-6 was increased 6 times (317.4 ± 53.5 pg/ml and 47.8 ± ± 11.2 pg/ml, respectively, at $p < 0.001$).

The level of anti–inflammatory cytokine IL-4 have increased by 4.3 times compared with the norm, which was statistically confirmed (157.5 ± 36.7 pg/ml and 32.6 ± 14.3 pg/ml, respectively, $p < 0.001$).

Thus, in patients with CP have found secondary immunodeficiency, for which we used to eliminate Thymoptinum applied in combination with basic therapy. Immunotherapy resulted to an increasing in both relative – 54.7 ± 3.2%, and the absolute values of T(CD3) –lymphocytes – 992.3 ± 64.8 cells/1 mcl of blood. At the same time, increasing and stabilization were observed in Th(CD4) and Ts(CD8). This immunoregulatory index consisted 2.2.

Carrying out traditional treatment in patients with CP was noted moderate decreasing levels of TNF–α, IL-6 ($p<0.05$; compared with the data before the treatment) and a weak increase in IL-4 and 172.3 ± ± 41.1 pg/ml. Influenced by immunocorrective therapy conducted on a back–ground of the traditional treatment, in patients with CP was revealed marked reduction of pro–inflammatory cytokines: TNF–α to 118.4 ± 29.1 pg/ml, IL-6 133.6 ± 51.8 pg/ml.

Moreover, it was observed the reduction in production of anti-inflammatory cytokine IL-4 95.2 ± ± 27.4 pg/ml.

Conclusions: The CP patients was observed significant changes in the functioning of most of the parameters of the immune system, namely the profound suppression of T (CD3) –lymphocyte subpopulations. In patients with CP it was revealed a trend in the growth rates of pro– and anti–inflammatory cytokines. The combination of traditional treatment and Thymoptinum is effective in patients with CP, as it contributed to the restoration and stabilization of most of the parameters of the immune system.

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DISORDERS OF IMMUNE REACTIONS AND THEIR IMMUNOREHABILITATION IN PATIENTS WITH DUODENAL ULCER

Abstract. The immunoreactivity was analyzed in 52 patients with duodenal ulcer (DU) and 36 healthy persons. The suppression of T-system and its subsets, a tension of humoral link of immunity was observed in patient.

The use traditional method of treatmend was not made a result to disorder of second immunodificiens in patients with DU.

The usage of Thymoptinum, the dose of which was 1.0 mg – 1.2 mg (in one course) at second group patients (n = 24) with DU cured immune disorder, increased cell immunity, and had immunocorrection and eradication features.

Keywords: the immune system, T- and B-link immunity, cellular immunity, humoral immunity, link, thymoptinum immunotherapy, duodenal ulcer, Helicobacter pylori.

Duodenal ulcer (DU) occupies an important place in the structure of diseases of the digestive system. According to world statistics its prevalence among the adult population of all countries reaches from 7 to 10%. The etiology of DU associated with Helicobacter pylori (HP infection) is associated with contamination of the mucous membrane (MM) of the gastroduodenal zone – GDZ (gastric MM – GMM and DMM) with these cytotoxic strains of these bacteria [1–4].

The development of various forms of gastroduodenal pathology depends on the resistance of the microorganism, and HP pathogenic strains can show their cytotoxic effect only when the immunobiological properties of the human body are reduced against the background of the developed immunodeficiency status [5–8].

The purpose of this study was to study the parameters of immunity in patients with DU and conduct antihelicobacter and immunocorrecting therapy in them.

Materials and methods. 52 patients with DU were examined, of whom 37 (71.2%) were men and 15 (28.8%) women aged from 23 to 54 years. The duration of ulcerative history was on average 6.2 ± 2.4 years. The diagnosis of exacerbation of DU was confirmed endoscopically. The average size (diameter) of the ulcers was 0.9 cm. Contamination of the GMM was determined by urease test. All patients showed a high degree of HP–infection. Depending on the treatment, the patients were divided into 2 groups: the 1st group (n = 28) received an eradication regimen consisting of Omeprazole (40 mg/day), De-nol (480 mg / day), Tinidazole (1000 mg/day) for 2 weeks; in the 2nd group (n = 24), the same treatment regimen with the 1st group was used, supplemented with Thymoptinum (Uzbekistan) (1 ml of 0.01%) solution subcutaneously every other day; for a course of 10–12 injections).

Cellular immunity was studied using monoclonal antibodies to CD receptors ("Sorbent Ltd", Russia)

of the Institute of Immunology of the Ministry of Health and Social Development of the Russian Federation. T-lymphocytes were determined (total population – CD3); T-helpers (subpopulation Th – CD4); T-suppressors (Ts subpopulation – CD8); B lymphocytes (subpopulation of CD19) and immunoregulatory index (IRI) – CD4 / CD8. The level of serum immunoglobulins of classes A, M and G was determined according to Mancini (1968). Circulating immune complexes (CIC) were detected by Hascova. Immunological examination was carried out for 2–5 days after the patient was hospitalized, and also 1 month after the treatment. The control group for comparison of immunological parameters was 36 practically healthy individuals (25–55 years).

The results of research and their discussion. In a retrospective analysis of the results of immunological examination presented in the tables 1, 2 it was found that the acute phase of DU was accompanied by a decrease in the level of the general population of T-lymphocytes (CD3). Differences were found in groups with different outcomes of eradication therapy: patients with the 1st group had a lower T-cell content in the blood than patients with the 2nd group. Also in both groups there was an imbalance of T-cell subpopulations with a decrease in their helper share (CD4) and an increase in the number of suppressors (CD8); a significant decrease in IRI and B-lymphocytes (CD19) was registered, which indicates profound changes in reactivity in patients with DU.

With exacerbation of DU in both groups, a significant decrease in IgA and IgM levels was observed with a simultaneous increase in IgG indices ($p < 0.01$ in the 1st; $p < 0.001$ in the 2nd group), which indicates violations in the humoral component of the immune system. Changes in immune homeostasis are also accompanied by a significant, 3-fold increase in the level of the CIC ($p < 0.001$).

Table 1. – Dynamics of changes in cellular immunity in patients with DU in the process of immunomodulatory therapy (M ± m).

Indicators		Patients of the 1st group	Patients of the 2nd group	Control group
CD3(%)	A	39 ± 1.2***	43 ± 2.3**	51 ± 2
	B	42 ± 1.4***	64 ± 2.6***	
CD4(%)	A	25 ± 0.9***	23 ± 1.1***	36 ± 0.7
	B	28 ± 1.4***	44 ± 1.6***	
CD8 (%)	A	15.1 ± 1.4	16.5 ± 1.3	17 ± 1.2
	B	16.2 ± 1.6	19.1 ± 1.0	
ICI	A	1.6 ± 0.2**	1.5 ± 0.2*	2.1 ± 0.1
	B	1.7 ± 0.1*	2.3 ± 0.2	
CD19(%)	A	11 ± 1.2**	11.7 ± 1.5	15 ± 1
	B	19.6 ± 0.7***	18.7 ± 0.5**	

Note: A – indicators before treatment, B – indicators after treatment; *– $p < 0.05$; **– $p < 0.01$; ***– $p < 0.001$ compared to control

The formation of a peptic defect is not only the result of local damage to the DMM against an imbalance of aggression and the protection of HP microbial contamination, but also a consequence of a breakdown in adaptation, an imbalance in the immune system. DU in most patients is associated with intestinal dysbiosis, microbial antigens of which can cause sensitization and exacerbate the immune deficiency in DUD patients [1, 2]. Healing of the peptic defect was achieved in a shorter time with successful eradication of HP (in the 1st group – for 24.8 ± ± 1.2 days with an eradication efficiency of 59%; in the 2nd group – for 17.3 ± 0.46 days with an effectiveness eradication 86%). After treatment, patients

with the 1st group had lymphopenia; the level of the total population of T-lymphocytes CD3 (Table) was reduced, as was its helper CD4 fraction (p < 0.01) with a high level of CD8 suppressors, which was sig- nificantly different from the corresponding param- eters of the 2nd group. A reduction in the IRI to 1.5 at a rate of 2.1 confirms the imbalance in the CD4 / CD8 system in patients with ineffective eradication.

Table 2. – Dynamics of changes in humoral immunity in patients with DU in the process of immunomodulatory therapy (M ± m)

Indicators		Patients of the 1st group	Patients of the 2nd group	Control group
IgA. g/l	B	13 ± 1.6	17.2 ± 2.1	
	A	2.2 ± 0.3	2.3 ± 0.4	2.8 ± 0.3
	B	2.5 ± 0.5	2.9 ± 0.2	
IgM. g/l	A	1.3 ± 0.1*	1.2 ± 0.2*	1.6 ± 0.11
	B	1.02 ± 0.2***	1.5 ± 0.2	
IgG. g/l	A	20.4 ± 0.6***	19.4 ± 0.8**	15.9 ± 0.9
	B	19.6 ± 0.7***	18.7 ± 0.5**	

*Note: A – indicators before treatment, B – indicators after treatment; *– p < 0.05; ** – p < 0.01; *** – p < 0.001 compared to control*

Patients of the 2nd group, after immunocorrective therapy, showed an effective increase in the number of T CD3, B cells (CD19) (Table), with a simultaneous increase in the proportion of Th (CD4) and IRI to 2.3 (normal 2.1), which was much higher than similar val- ues from the 1st group (p < 0.001). Apparently, a posi- tive shift in the functioning of the T-cell (an increase in CD3, CD4 and a decrease in CD8) component of the immune system contributes to the eradication of HP. In addition, an increase in B-lymphocytes (CD19) and IgA levels was observed in this group compared to the data before treatment (p < 0.001) (Tables 1, 2).

Thus, DU in the recurrence stage is character- ized by a deep deficit of most of the parameters of the body's immune system with a high HP infec- tion of GMM and DMM. Predictors of ineffective eradication are a significant decrease in the number of CD3, CD4 and IRI, as well as a decrease in the concentration of Ig A. On the contrary, clinical and endoscopic remission of patients of the 2nd group (immunomodulating therapy) was accompanied by a significant increase in the parameters of cellular- humoral immunity, which positively affected the re- sults of eradication and immunocorrective therapy.

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Section 2. Life Sciences

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THE IDENTIFICATION OF CEREBRAL HAEMORRHAGE THROUGH HEAD CT IMAGES AND COMPARISON OF THREE CONVOLUTIONAL MODELS

Abstract

With modern computers and medical advancements, we can find a better way to increase efficiency and reduce human error in the healthcare system. In computer vision, machine learning models can analyze and categorize patients' head CTs. This diagnosis process is faster and retains the accuracy of experienced healthcare professionals. In this study, we used deep learning algorithms to identify cerebral haemorrhage in CT images with different CNN (convolutional neural network) architectures – exception and inception. Cerebral haemorrhage is one of the most complex diseases to diagnose and treat in the world. By comparing the performances of simple CNN, exception model, and inception model, we can find the best model for this task.

Keywords: Cerebral Haemorrhage, Head CT Interpretation, Convolutional Neural Network, Inception Model, Xception Model.

1. Introduction

AI (Artificial Intelligence) is a popular field continuously being developed nowadays. One of the main applications of AI is in processing and interpreting images by heavily studying medical interpretation, healthcare professionals, and AI scholars. Cerebral haemorrhage is severe bleeding that happens into or around the brain tissue. People who had cerebral haemorrhage could lose essential functions such as speaking, walking, or understanding others. Even though they can go through rehabilitation therapy and get better, it is still a painful for the patients and their family members. For example, my uncle has a loving family with a steady job and a cute daughter. Yet, a cerebral haemorrhage destroyed all of these. Their life became ominous; my poor aunt had to attend to her daughter and husband simultaneously. Watching them go through this, I become interested in researching how we can detect cerebral haemorrhage effectively and inflict less pain on happy families. AI is one way to do it. Trained machine learning models can quickly determine whether a cerebral haemorrhage is happening by comparing the scanned Head CT images to the training data. This approach will be much more efficient and accessible than having each image analyzed by doctors.

1.1 What is neural network

Neural Network is a structure for computers to learn to identify pictures like the human brain. A Neural Network contains three layers: an input,

hidden, and output layer. Each layer has some neurons that contain values of the picture. The picture is first changed into black and white and then separated into several pixels; each pixel has a value between 0.0 to 1.0 based on its grayscale; 1.0 is white, and 0.0 is black. Then these values are stored in the input layer.

The computer then will use an algorithm to calculate the values and transfer those to the hidden layer. A Neural Network could have several hidden layers; each hidden layer's values depend on the upper hidden layer. Then, the final hidden layer calculates a value converted to an output label (See Figure 1).
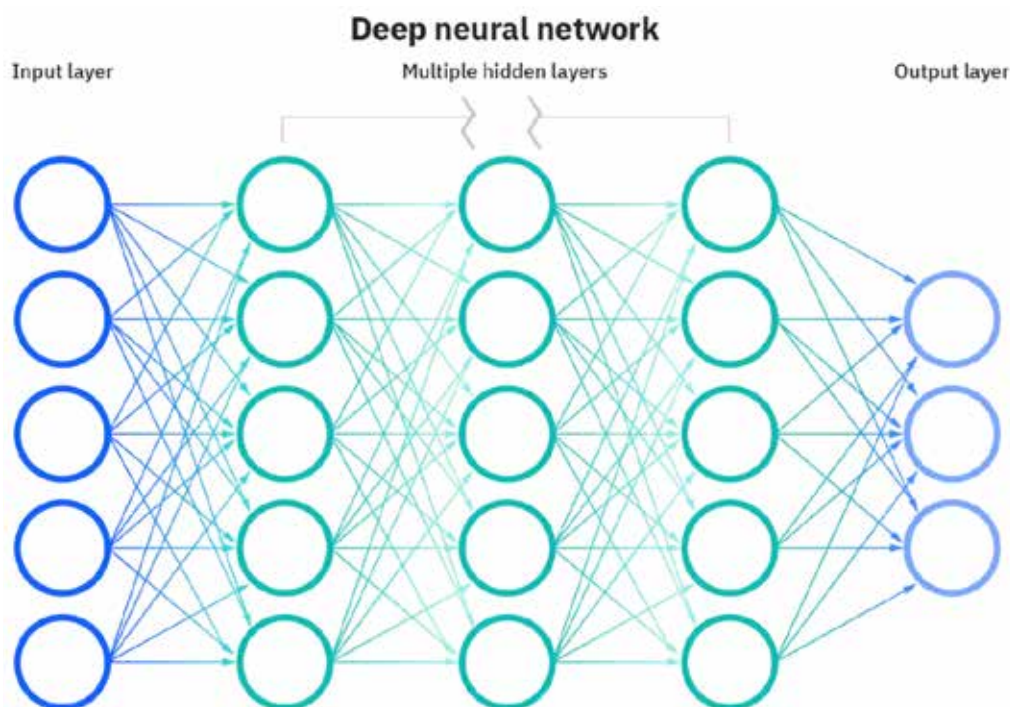

Figure 1. Simple Layers Structure of Neural Network

1.2 What is CNN

Convolutional Neural Network (CNN) is a deep learning algorithm that significantly contributes to image interpretation. There are mainly four parts to a CNN: Convolution, Padding, Striding, and Pooling. To begin with, Convolution is the most essential part of a CNN. It makes a feature map as the input image passes the filter layer. The new feature map decides the information gathered from the original image. The collected data depends on the dimension of the filter (See Figure 2). The filter moves at least one step for each pixel. For instance, if an m*m image passes through an n*n filter layer, the outcome image will be $[(m–n) +1] * [(m–n) +1]$. In other words, it picks some information from the original image and makes a new image containing these values. In this case, some of the information might be lost. Then,

Padding helps to solve this problem. During the Padding process, the computer adds pixels on the margin of the filtered image that helps replenish some of the lost information based on the marginal pixels.

Padding the image size to be $n + 2p – f +1$. In the formula, n is the standard matrix dimension, p is the padding size, and f is the filter dimension. However, in some cases, people want to avoid the original picture passing the filter one step at a time; striding comes in for this. Striding means the filter can move more than one pixel, and the outcome image shape will be $(n + 2p – f) / s = 1$ (here, n, p, and f are defined the same as the formula above, and s is the unit of strides). Lastly, pooling helps the machine compute faster. It cuts the image into pieces and does specific calculations. There are two classical instances: max pooling and average pooling. Max pooling means picking the maximum

value in each piece. Average pooling means calculating the average value of each piece.

Using CNN has several advantages compared to the traditional artificial neural network. First, nowadays, machine learning algorithms usually have to process large images. By convoluting the image, it will give the computing process less pressure. Convoluting the image will give the computing process less pressure because of the convolution. Several

pixels pass the filter and become one pixel for the feature map. As a result, it will make the size smaller than the previous input. Secondly, CNN can identify the same target at different positions, an improvement from the traditional neural network. Finally, having multiple filters (one filter outputs one feature map) in a convolutional layer, simultaneously, several filters are applied to its input. Thus, it is capable of detecting multiple features anywhere in the input.
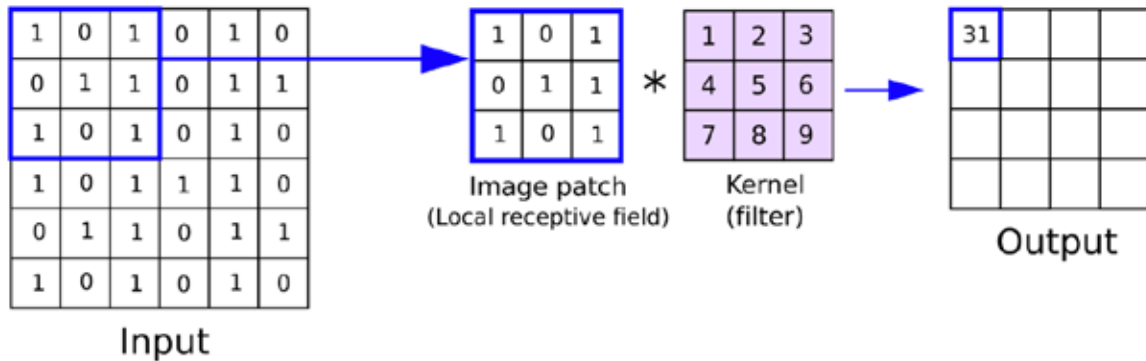

Figure 2. Simple Illustration of How CNN Layers Work in Convolution Process

1.3 How to Train a CNN Model

There are mainly two steps in training a CNN model: a forward phase and a backward phase, also known as backpropagation (backward propagation of errors). In the forward phase, it lets the image data go through the network from the input layer to the output layer. Each layer of the model will cache the image information. In backpropagation, it compares the output (prediction) to the original image label. Then it calculates the gradient for each layer of weights from the output layer back to the input layer – the neural-network version of gradient descent, which is to minimize the cost function. In the final layer, the activation function, SoftMax, calculates the possibility of the correct class. The loss function used is the cross-entropy loss. In other words, this algorithm helps to identify the labels.

$$L = -\ln(\rho_c)$$

The above formula is the Cross-entropy Loss. The P_c means the possibility of the correct class. Therefore, P is the possibility, and c is the suitable class.

1.4 Project Objective

This project aims to develop the best model to mark cerebral haemorrhages in CT pictures. Models included are regular CNN, Inception, and Xception, identifying the most efficient and accurate model by comparing their performance. In this project, by using transfer learning – using the model In this project, the accuracy of the model is improved by using transfer learning – using the model pre-trained by large amounts of data (imagenet). As a result, the absolute accuracy of the xception model is 0.93, which is the highest accuracy among all other models used in this project.

2. Methods

2.1 Preparation

The first step is to import the cerebral haemorrhage CT pictures and their corresponding labels to the Collaboratory notebook (the coding environment). Then, the heights and widths of the photographs were examined and unified. The original dataset included half normal brain CT and half cerebral haemorrhage CT images (See Figure 3).
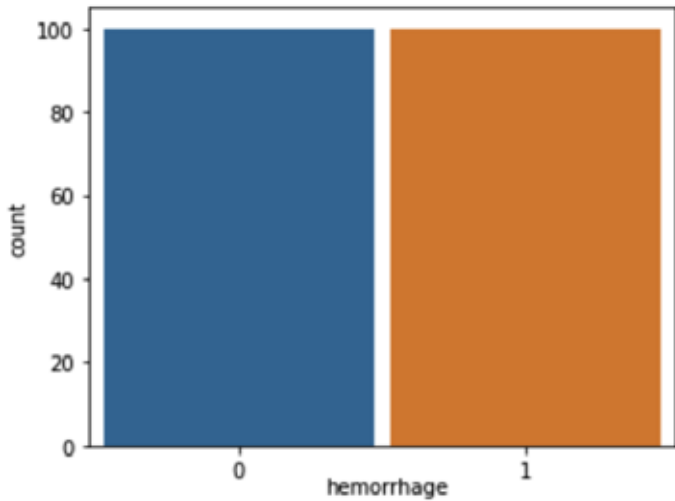
Figure 3. Count Plot of Labels

Selected and grouped at random, 60% of the pictures as the training data, and the rest were validation and test data.

2.2 Image Augmentation

Image augmentation can help CNN learn better by the invariant transformation pictures to feed the model for training, meaning that a photo will copy itself and make some shifts horizontally or vertically (See Figure 4). The CT scan produces nine images. It helps to increase the diversity of the training samples for the model. This step is crucial because deep learning requires a lot of data to train. The more training sample it has, the less overfitting there will be and the more accurate judgment it will make – just like the human brain completing the preparation.
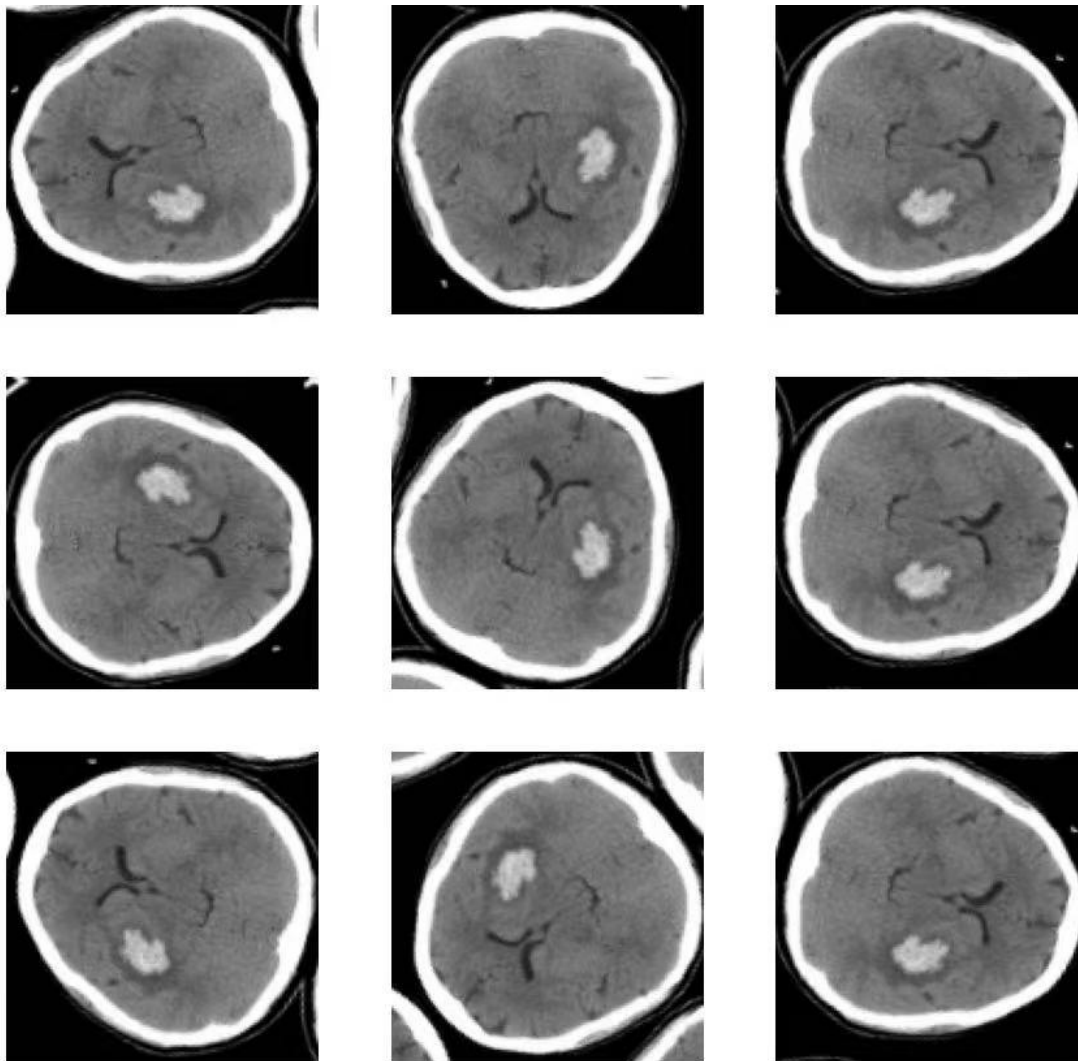

Figure 4. Image of Head CT After Image Augmentation

2.3 Transfer Learning

Transfer learning means to pre-train the model using a large database (imagenet) and applying the pre-trained model to similar problems. Transfer learning can also add specific criteria to solve complicated issues, especially computer vision problems. Moreover, not all transfer learning model is suitable for the project. Therefore, researchers need to determine which part of the research is valuable and if any necessary modifications and retesting might be required. In other words, it will transfer the knowledge that that applies to the current project and be trained with the existing data to become a new model to solve a specific problem. In my research, transfer learning helps to reduce training time, solve the small dataset problem, and to adapt to new images.

2.4 Simple CNN Model

A simple CNN model is the first model used in the computer vision problem. As mentioned before CNN model will convolute the input images from the input layers and then transfer them to other layers.

In the project, the simple CNN model used transfer learning to pre-train the base model. Unfortunately, in the outcome, the simple CNN model only has an accuracy of 0.59 (See Figure 5), which is the worst model in this project.

```
Epoch 23/30
5/5 [==============================] - ETA: 0s - loss: 0.6898 - accuracy: 0.6000WARNING:tensorflow:Can save best model only with val_acc available, skipping.
5/5 [==============================] - 1s 104ms/step - loss: 0.6898 - accuracy: 0.6000 - val_loss: 0.6979 - val_accuracy: 0.3750
Epoch 24/30
5/5 [==============================] - ETA: 0s - loss: 0.6885 - accuracy: 0.5667WARNING:tensorflow:Can save best model only with val_acc available, skipping.
5/5 [==============================] - 1s 116ms/step - loss: 0.6885 - accuracy: 0.5667 - val_loss: 0.7083 - val_accuracy: 0.3750
Epoch 25/30
5/5 [==============================] - ETA: 0s - loss: 0.7047 - accuracy: 0.3929WARNING:tensorflow:Can save best model only with val_acc available, skipping.
5/5 [==============================] - 1s 102ms/step - loss: 0.7047 - accuracy: 0.3929 - val_loss: 0.6983 - val_accuracy: 0.5000
Epoch 26/30
5/5 [==============================] - ETA: 0s - loss: 0.6946 - accuracy: 0.5000WARNING:tensorflow:Can save best model only with val_acc available, skipping.
5/5 [==============================] - 1s 105ms/step - loss: 0.6946 - accuracy: 0.5000 - val_loss: 0.6905 - val_accuracy: 0.5000
Epoch 27/30
5/5 [==============================] - ETA: 0s - loss: 0.6925 - accuracy: 0.5536WARNING:tensorflow:Can save best model only with val_acc available, skipping.
5/5 [==============================] - 1s 112ms/step - loss: 0.6925 - accuracy: 0.5536 - val_loss: 0.6885 - val_accuracy: 0.6250
Epoch 28/30
5/5 [==============================] - ETA: 0s - loss: 0.6860 - accuracy: 0.6786WARNING:tensorflow:Can save best model only with val_acc available, skipping.
5/5 [==============================] - 1s 108ms/step - loss: 0.6860 - accuracy: 0.6786 - val_loss: 0.6710 - val_accuracy: 0.6250
Epoch 29/30
5/5 [==============================] - ETA: 0s - loss: 0.6884 - accuracy: 0.5333WARNING:tensorflow:Can save best model only with val_acc available, skipping.
5/5 [==============================] - 1s 114ms/step - loss: 0.6884 - accuracy: 0.5333 - val_loss: 0.6828 - val_accuracy: 0.5000
Epoch 30/30
5/5 [==============================] - ETA: 0s - loss: 0.6868 - accuracy: 0.5893WARNING:tensorflow:Can save best model only with val_acc available, skipping.
5/5 [==============================] - 1s 101ms/step - loss: 0.6868 - accuracy: 0.5893 - val_loss: 0.7233 - val_accuracy: 0.3750
<keras.callbacks.History at 0x7f4fbcd961d0>
```

Figure 5. Result of Simple CNN Model

2.5 Res Net

With the development of deep learning, models are getting deeper and deeper. However, one problem appeared: sometimes more layers a model has, the worse it will perform. In simple words, residual learning helps the machine have more layers without losing information during deep learning. Initially, a model with x layers is as accurate as the x + 1 layer's model when just copying previous layers and identities of the last layer. However, it does not; the accuracy is gradually decreasing. To solve this issue, the author of ResNet started with the hypothesis that it's hard for the machine to learn direct information. In this case, ResNet helps it to learn a function by learning the differences. For instance, instead of learning a function F(x) directly, ResNet blocks will attempt to learn G(x) + x when F(x) = G(x) – x. Each block of the ResNet can add the features element-wise (See Figure 6). This method essentially helped solve the problem of vanishing gradient, which means losing the gradient signals since they cannot trace back to previous layers. By using ResNet, signals are allowed to travel back to early layers.
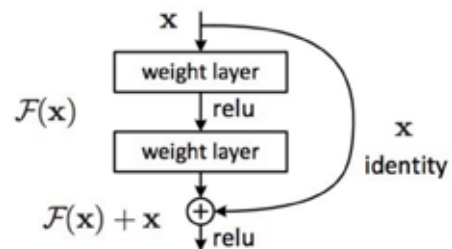

Figure 6. ResNet Block

2.6 Inception

From the regular convolutional neural network, each output image comes from the previous lay-

ers. If there are lots of hidden layers, it increases the computational cost. In this case, the Inception model solves this problem by using parameters more efficiently. Instead of convolute each layer for one filter board, Inception does this more comprehensively, which means the input signal is fed to four different layers. Each layer uses a different kernel size, allowing them to capture patterns at different scales, as shown in (Figure 7). There is a one-by-one convolution layer, a three-by-three con-

volution layer, a five-by-five convolution layer, and a three-by-three max pooling layer. The final depth concatenation layer stacks the feature maps from all four previous layers. In simple words, the inception module can output feature maps that capture complex patterns at various scales.

In the project, using transfer learning, the inception model has a final result of 0.91 accuracy (See Figure 8). The result is the second-highest accuracy compared to other models.
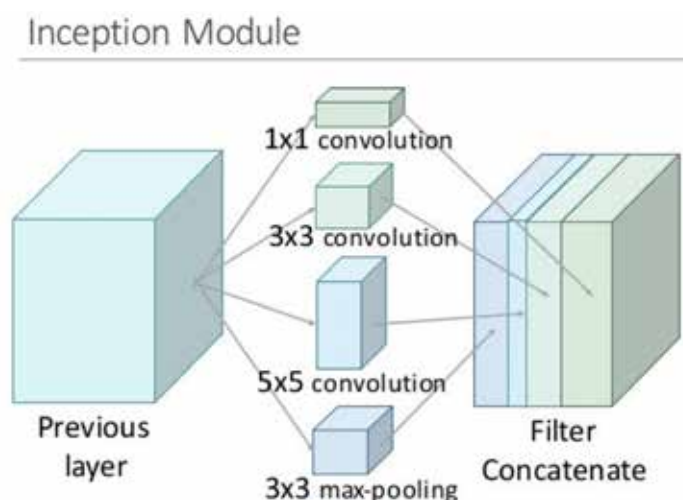

Figure 7. Inception Model

```
Epoch 37/50
10/10 [==============================] - 6s 596ms/step - loss: 0.5981 - acc: 0.8707 - val_loss: 2.0838 - val_acc: 0.7000
Epoch 38/50
10/10 [==============================] - 6s 603ms/step - loss: 0.3499 - acc: 0.8966 - val_loss: 0.8971 - val_acc: 0.7667
Epoch 39/50
10/10 [==============================] - 6s 615ms/step - loss: 0.2385 - acc: 0.9250 - val_loss: 0.9257 - val_acc: 0.8000
Epoch 40/50
10/10 [==============================] - 6s 599ms/step - loss: 0.2961 - acc: 0.9138 - val_loss: 0.5304 - val_acc: 0.8667
Epoch 41/50
10/10 [==============================] - 6s 608ms/step - loss: 0.2641 - acc: 0.9310 - val_loss: 1.9825 - val_acc: 0.7333
Epoch 42/50
10/10 [==============================] - 6s 603ms/step - loss: 0.3547 - acc: 0.8879 - val_loss: 0.9659 - val_acc: 0.6667
Epoch 43/50
10/10 [==============================] - 6s 599ms/step - loss: 0.3403 - acc: 0.8879 - val_loss: 0.7347 - val_acc: 0.8333
Epoch 44/50
10/10 [==============================] - 6s 599ms/step - loss: 0.2218 - acc: 0.9397 - val_loss: 0.6657 - val_acc: 0.8333
Epoch 45/50
10/10 [==============================] - 8s 806ms/step - loss: 0.2349 - acc: 0.9397 - val_loss: 0.2902 - val_acc: 0.9000
Epoch 46/50
10/10 [==============================] - 6s 613ms/step - loss: 0.4064 - acc: 0.9052 - val_loss: 1.4271 - val_acc: 0.6667
Epoch 47/50
10/10 [==============================] - 6s 618ms/step - loss: 0.2383 - acc: 0.8917 - val_loss: 1.2422 - val_acc: 0.8000
Epoch 48/50
10/10 [==============================] - 6s 599ms/step - loss: 0.3446 - acc: 0.9224 - val_loss: 0.6930 - val_acc: 0.7667
Epoch 49/50
10/10 [==============================] - 6s 614ms/step - loss: 0.2635 - acc: 0.9333 - val_loss: 0.9450 - val_acc: 0.7667
Epoch 50/50
10/10 [==============================] - 7s 727ms/step - loss: 0.3260 - acc: 0.9167 - val_loss: 2.1420 - val_acc: 0.7333
```

Figure 8. The Result of Inception Model

2.7 Xception Model

Xception means the extreme inception. In other words, it allows the inception model to be the most efficient at training and testing. The difference between the inception model and the exception model is the depth-wise separable convolution layer based on the idea of spatial and cross-channel patterns can be modeled separately. The separable convolution layers have one spatial filter per input channel. In detail, it filters the input image first and then compresses it into the 1 * 1 deep convolutional compression to catch the Cross-Chanel correlation (See Figure 9). It also includes a depth-wise convo-

lution and a point-wise convolution which means to break mapping 3D models by mapping it by 1D model plus 2D model. As a result, it decreases the computational cost. Secondly, after the operation, the exception model will not introduce any nonlinearity. Therefore, the exception model increases the image interpretation accuracy and performs better in big data analysis.

In this project, using transfer learning- improves the model's accuracy. As a result, the final accuracy of the xception model in the project is 0.93 (See Figure 2.7.2), which is the highest accuracy among all other models tried in this project.
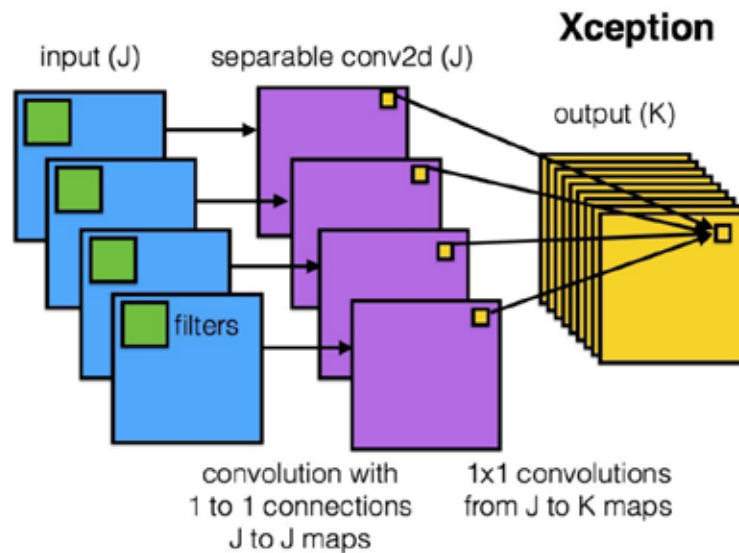

Figure 9. The Simple Structure of Xception Model

```
Epoch 20/30
12/12 [==============================] - 17s 1s/step - loss: 0.0675 - accuracy: 0.9714 - val_loss: 0.2447 - val_accuracy: 0.9333
Epoch 21/30
12/12 [==============================] - 17s 1s/step - loss: 0.1951 - accuracy: 0.9429 - val_loss: 0.1567 - val_accuracy: 0.9667
Epoch 22/30
12/12 [==============================] - 17s 1s/step - loss: 0.2022 - accuracy: 0.9286 - val_loss: 0.1170 - val_accuracy: 0.9667
Epoch 23/30
12/12 [==============================] - 17s 1s/step - loss: 0.1691 - accuracy: 0.9429 - val_loss: 2.0324 - val_accuracy: 0.9000
Epoch 24/30
12/12 [==============================] - 17s 1s/step - loss: 0.1456 - accuracy: 0.9429 - val_loss: 2.8704 - val_accuracy: 0.9000
Epoch 25/30
12/12 [==============================] - 17s 1s/step - loss: 0.1207 - accuracy: 0.9643 - val_loss: 0.0920 - val_accuracy: 0.9333
Epoch 26/30
12/12 [==============================] - 17s 1s/step - loss: 0.1350 - accuracy: 0.9357 - val_loss: 1.1020 - val_accuracy: 0.9000
Epoch 27/30
12/12 [==============================] - 17s 1s/step - loss: 0.2485 - accuracy: 0.9714 - val_loss: 0.8050 - val_accuracy: 0.9000
Epoch 28/30
12/12 [==============================] - 19s 1s/step - loss: 0.2272 - accuracy: 0.9786 - val_loss: 0.0318 - val_accuracy: 0.9667
Epoch 29/30
12/12 [==============================] - 17s 1s/step - loss: 0.2044 - accuracy: 0.9786 - val_loss: 0.8140 - val_accuracy: 0.9333
Epoch 30/30
12/12 [==============================] - 17s 1s/step - loss: 0.1648 - accuracy: 0.9357 - val_loss: 2.5372 - val_accuracy: 0.9000
```

Figure 10. The Result of Xception Model

3. Conclusion

The results show that some models, such as the Xception and inception models, performed much better than the simple CNN model in identifying whether the Head CT images have a cerebral haemorrhage. Comparing their performances, Simple CNN only had 46% accuracy while the other two (inception model and Xception model) had about 91% and 93%. Hence the Xception model is the model of choice for this research.

Based on the National Institute of Health, ten in every 100.000 people in the United States get cerebral haemorrhage. It is a considerable number in total and still increasing every year. Several reasons, such as head trauma, blood vessel anomalies, cerebral aneurysm, or some liver illness, may cause cerebral haemorrhage. The symptom will happen imminently with severe headaches and loss of balance. In addition, people with cerebral haemorrhage might lose consciousness, mobility, and linguistic abilities. In this project, by using machine learning models, we can identify whether a patient has cerebral haemorrhage through the CT image with faster and more accurate results. It will significantly increase the efficiency of hospitals in the diagnosis phase, which is particularly important in remote areas where the lack of medical professionals is a problem.

This study shows machine learning potential to decrease the damage and total rate of patients who suffer from this disease. However, some questions remain for further research, such as whether other models or combining different models achieve better accuracy and whether a larger dataset with more variations will change the result. I hope to keep working on this topic so that machine-learning models for cerebral haemorrhage identification can become a reality and be widely used by the public.

Acknowledgment

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ASSESSMENT OF THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND COGNITIVE FUNCTIONING IN CHILDREN AND ADOLESCENTS

Abstract. The benefits of being physically active on a person's overall health are well-documented. Over the last decades, scholars have attempted to investigate the potential interrelationship of physical activity, physical fitness, and cognition, the latter a term used to indicate general mental processes. The number of peer-reviewed articles on this subject is rapidly increasing. However, from the literature review it results that researchers are divided when it comes to establishing the positive impact that physical exercises have on a person's cognitive performance, especially among school age children. Early research suggested that intense physical activity causes fatigue, which has a negative impact on a student's academic performance. This theory supports parents' and teachers' long-held concerns that the time children spend while participating in physical activity affects their academic results. Therefore, physical education programs are being cut at an incredibly fast rate so that students devote more time while engaging in basic academic activities. On the other hand, a considerable number of studies have identified the positive or at least neutral effects of physical activity on academic achievements. As a result, based on the conflicting evidence, more research needs to be carried out in order to investigate the connection between physical activity and students' results in school subjects. Our objective is to review research findings on the impact of sports activities and the level of physical fitness on children's cognitive and mental health.

Keywords: mental performance, academic achievements, physical fitness, cognition, motor skills.

Introduction

Physical educators frequently complain that a number of school administrators, teachers, and parents regard physical education as a secondary school subject in which students simply stretch their legs, build muscle, or kick a ball. Some parents refuse to allow their children to participate in sports or exercise, preferring instead to keep them at home reading a book. As Zervas, Danis, and Klissouras pointed out in their study, the implication behind it

is that they undervalue the positive effects of being physically active in the children's development [1]. This goes in line with the traditional belief that rigorous physical activity produces fatigue, which in turn might negatively impact mental activity. This theory has also found scientific support in several early studies concluding that physical exertion negatively impacts children's cognitive ability [2; 3; 4]. One of the critical factors in determining whether physical activity produces positive or negative results in tests which assess mental performance appears to be one's level of physical fitness [5]. The goal of this study was to review literature with the focus on identifying a potential link between physical fitness parameters and sustained attention on a cognitive task.

Historical Background

Organic, motor, and cultural components can all be found in the concept of physical fitness, as demonstrated in the handbook for the Eurofit test on physical fitness. This concept was the first research approach. The development of psychomotor capacities required for movement control, as well as muscular skills required to perform some motor tasks, is part of the motor dimension of physical fitness. This extremely complex component is commonly referred to as "motor fitness". It can't be measured with just one test; it requires a combination of tests that each measure a different factor. The organic dimension, which is closely linked to an individual's physical appearance, is concerned with energy production and output processes. The third facet of the physical fitness triad is the cultural dimension. It refers to and reflects the impact of factors such as the current state of affair of physical education in a country's system of education.

In 1967, Ismail and Gruber concluded that measures of coordination and balance were found to be in the long-term good predictors of a child's academic results. The impact of single, or acute, bouts of physical activity on participants' behaviour and mental performance is the focus of the second research approach. The effect of single bouts of physical exertion on behaviour and cognition is measured while the individual is exercising or shortly after the exercise has ended. A number of scholars have come to the conclusion that acute bouts of exercise help adults with specific aspects of cognitive functioning [6; 7; 8; 9].

Acute bouts of physical activity, according to the literature, have positive short-term effects on the behaviour and cognitive performance of young adults exhibiting no clinical disorders. However, physical activity has also been found to have a positive effect in young aged individuals, who have a medical history of inability to stay focused, control impulsive behaviour, or engage in demanding motor activity [6; 10; 7; 11; 12; 13; 14]. The benefits of exercise training, on the other hand, were limited to improvements in children's physiological functioning [8].

Relationship of between physical activity and psychological well-being

Children engaging on a regular basis in different forms of movement activity display improved psychological conditions. While children exercising less often exhibit a number of symptoms resulting from emotional distress, as compared to their more active counterparts. There is a link between physical activity and happiness that exists regardless of social class or health status as Mutrie and Parfitt identified in their revision of literature [15]. Physical activity in general appears to be beneficial for the emotional and psychological well-being of young adults, according to current evidence [13]. Sport and exercise can provide a valuable platform for young people to succeed, as evidenced by the resulting positive effects such an improved sense of personal worth, a higher level of perceived competence along with a better concept of their body image [15], with a stronger effect observed in the individuals who already display low levels of self-esteem. In addition, physical activity is found to have a positive effect, even though on a small scale, in relieving psychological complaints resultant from stress, anxiety, and depression among teenagers [9].

Children who are physically active have a greater likelihood to perform better in cognitive tasks as compared to their peers who exercise less. However, there isn't much solid experimental proof to back up this theory [9]. There is evidence that increasing the amount of time spent in school on health-related physical education does not impact at all children's school results and benefits children's health significantly [8; 9]. Even regular participation in sports does not impact negatively academic performance [6; 7; 9].

Earlier studies on the effects of daily physical activity on mathematics and reading performance found that there was no decline in academic performance despite the decreased amount of academic time spent engaging in the subject matters of science, mathematics, reading, language arts, and/ or social studies in order to provide more time for physical activity [16; 17].

Discussion

In P. E., the concept of motor skills is very important [18]. Even though some motor skills, such as walking or running, are highly over-learned, it is clearly an essential prerequisite for participation in virtually any physical activity or sports activity. If motor skills are learned incorrectly at a young age, they can limit performance at a higher level [5].

The ability to focus on relevant cues is directly proportional to one's chances of cognitive functioning and learning a task. Concentration refers to the ability to maintain complete focus on a single task at the expense of everything else. An individual's ability to pay attention is linked to their awareness of the constantly changing environment. The ability to concentrate and pay attention are critical components of the learning process. According to Abernethy, there can be hardly anything more important in learning and performing a specific sport skill than paying attention to the task at hand [19]. Processes linked to attention have been employed to describe how both cognitive and motor task learning are affected by information processing.

In order to appreciate the fact that good intellectual development can lead to good motor test results, there is a need to investigate the link between intellectual development and motor abilities. According to Assainte posture is extremely important to maintain balance while starting the movement, and also during the movement [20]. Therefore, there is a strong link between concentration and balance, which in turn is also linked to academic results. Those who have good concentration want to get better grades and excel at games that require concentration and attention. As a result, if they participate in these types of games, they will display higher levels of self-esteem and will attend more PE classes. Some psychological constructs have been considered multidimensional by researchers, most notably self-concept [21; 22; 23] that has now been conceptualized as multidimensional and hierarchical. Placed highest in the hierarchy is the general or overall concept which indicates how a person views oneself from the perspective of others, commonly referred to as self-concept. Self-concept comprises six domains including the social, academic, and physical domains. The domains are further classified into sub-domains and as children enter into adolescence the differentiation grows deeper [22]. Although the physical domain is inherently associated with physical activity and the respective health benefits deriving from it, research investigating mental well-being needs to take into consideration global self-esteem. In this case, more than one questionnaire would be required to have a better consideration on the Intelligence of those who participate in the testing, such as IQ tests or questionnaires on self-concept and self-esteem [21; 22; 23].

Early research that looked into the possibility of physical activity impairing cognitive performance of young aged-adults found that exercise actually improved rather than debilitated their performance. Gabbard and Barton assessed mathematical skills of 106 sixth grade boys and girls, before and after vigorous physical activity [24]. The accuracy of children's math computations was not harmed by

the exercise, but it was significantly improved. These findings were interpreted as proof of a relaxation state induced by exercise, during which children were able to improve their concentration. McNaughten and Gabbard tested the speed and accuracy in solving mathematical tasks of 120 sixth-grade boys and girls after they went for a 20- to 40-minute paced walk [25]. When the evaluation was done in the afternoon and midday, there was a significant improvement. Caterino and Polak discovered that physical exercises facilitate cognition in children [16]. They compared the effects of 15 minutes of vigorous aerobic exercise versus 15 minutes of stretching exercise on the Woodcock-Johnson Test of Concentration, which requires rapid stimulus identification and matching. Following aerobic exercise, only the fourth-grade students' performance improved significantly. The findings of these studies suggest that children's later academic performance is unaffected by scheduled periods of physical activity; indeed, the evidence, while limited, suggests that exercise may, in some circumstances, improve cognitive performance following periods of vigorous exercise.

Bass evaluated by means of a multiple-baseline design method the effects of 45-minute runs on attention and impulse control in six children from the ages of 8 to 11 [10]. Five out of six children improved their classroom attention and four improved their impulse control as a result of the exercise.

Croce and Horvat demonstrated the ergogenic how acute exercise sessions affect cognition in adolescents with mild intellectual disability in laboratory studies [26]. The authors concluded that the positive results that physical activity brings on children's cognitive performance vary according to exercise intensity and fitness level of the subjects.

According to research, the effects of strenuous physical activity on the ability to concentrate and pay attention vary significantly and are primarily dependent on how intense the exercise is and the time span of the exercise. Most of the evidence that support the health benefits of physical activity on a child's psychological state are founded on single bouts of physical activity or are gathered from cross-sectional studies in the form of self-report questionnaires. Since the positive impact of regular physical activity on children's development remains still unexplored, studies need to address the relationship between physical activity done on a regular basis and children's well-being [12; 27; 15]. Unfortunately, methods for evaluating physical activity among children have been questioned [28; 29; 13]. Davey studied how physical exertion impacted attention using various intensities of physical activity, concluding that moderate physical exertion improves attention [12]. However, the study is limited in that it fails to determine the level of physical activity that the children engaged in the gym hall. However, the goal was to demonstrate that a typical day in PE class did not reduce children's concentration and attention; rather, they were more concentrated after the PE lesson, implying that PE had no negative impact on their grades; however, those with better grades have even better basic motor abilities, and the speed of movement was not affected by concentration; perhaps it is affected by other factors. With a p value of 0.05, differences between two groups in the balance and concentration results were significant. So, it's possible that their increased attention is the reason for their improved cognitive performance and academic grades, as well as their improved balance, but not their movement speed. Of course, there are some flaws with the tests; for example, the children were classified according to their chronological age rather than their biological age [30], which may have influenced the results; however, the link between attention and concentration and academic average marks and balance was statistically significant, implying that there is a strong link. The academic achievement and the speed test did not have a significant correlation. The relationship between academic achievement and results in balance and concentration was significant (r = 0.8), but not so much with speed.

From the revision of the later literature, bouts of physical activity cause transient changes in cognitive processes that control the allocation of attention resources [9]. Skills and associations acquired during physical activity are transferable to learn additional relationships and models. This suggests that rather than the physical effort, the movement itself producing the activity, is important. According to Piaget, an IQ test is required for a more accurate assessment of intelligence development as well as the evaluation of more determinant variables in order to obtain a deeper insight into the effects that these variables have [31]. It is necessary to divide the subjects into groups based on biological rather than chronological age. Finally, the tests are practical and applicable in school situations, in addition to their suitability for survey purposes in large-scale projects. As a result, simple test versions were preferred over more complex ones, without jeopardizing the other validity, reliability, and objectivity criteria. The EUROFIT tests provide useful information about a person's basic motor abilities; however, they are not well suited to assessing or predicting a person's level of technical sports abilities [32]. Because each test measures a different aspect of motor fitness, it's impossible to create a hierarchy between them. While boys tend to outperform girls in terms of speed, girls may outperform boys in terms of balance.

Conclusions

The literature review that looked into the studies exploring the link between physical activity and children's cognitive ability, show that contrary to the findings of earlier studies, physical activity improved rather than impaired children's academic performance. Improvements in cognitive performance are statistically more significant following periods of vigorous exercise. Based on relevant research, the impact of physical exercises on concentration and attention vary significantly and depend primarily on the intensity and duration of the exercise. The majority of evidence that supports the benefits of physical activity on children's psychological well-being is based on single/acute bouts of physical activity. Consequently, it is necessary to consider the effect of habitual physical activity levels on children's wellbeing.

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