

MORPHOLOGICAL, CYTOLOGICAL, BIOCHEMICAL AND BACTERIOLOGICAL STUDY OF CEREBROSPINAL FLUID (CSF) IN CHILDREN'S MENINGITIS

Ionuț Stoica, Răducanu Dumitra, Daniela Tiță, Maria Prisecaru

Key words: *cerebrospinal fluid, biochemical examination, cytological examination, bacteriological examination, meningitis, children*

INTRODUCTION

In Romania, bacterial meningitis has a mortality rate of over 50%, the most affected being children under the age of 5, with an incidence of 15 cases per 100,000 inhabitants in a year.

The Romanian Society of Pneumology (SRP) supports preventive behavior in the fight against meningitis and its severe health complications and thus joins the project initiated by The Confederation of Meningitis Organizations (COMO) "Join Hands", which aims to make known the danger on which this condition represents. Starting from 2010, COMO is actively involved at the international level through educational actions regarding the danger of meningitis.

The most effective way to prevent bacterial meningitis is immunization through vaccination, especially since children, in the first 5 years of life, do not have a solid anti-infectious defense. Around the world, although important steps have been taken in the direction of education towards preventive behavior, there are countries that still do not have access to vaccines that could save lives and prevent the severe side effects of the disease.

The paper presents a study on cases of meningitis in children hospitalized at the Bacău County Emergency Hospital, Infectious Diseases Department, during 2021-2023, activity carried out in the hospital's speciality laboratory.

MATERIALS AND METHODS

18 cases from 2021, 17 cases from 2022 and 15 cases from 2023 were analyzed, in total 50 children, boys and girls.

The following were recorded: the child's age, sex, environment of origin, the main biochemical parameters (amount of glucose, proteins, chlorine, number of elements, cytochemical parameters (normal or pathological cytology, presence of pathogens - meningococcus, pneumococcus, diplococcus) such as and the macroscopic appearance

of the cerebrospinal fluid (color, transparency, appearance).

The following working methods were used:

- Macroscopic examination (color, degree of transparency, general appearance);
- Microscopic examination;
- Pandy reaction;
- Number of elements/mm³ (using the Bürcher-Fuchs counting chamber);
- Examination of the sediment (obtained by centrifugation at 250 revolutions/minute for 30 minutes);
- Bacteriological examination by seeding on agarose plates and incubation at 37° C for 24 hours
- Execution of smears and microscopic examination.

RESULTS AND DISCUSSIONS

All investigated children have the diagnosis of meningitis of different etiologies: viral (serous meningitis, acute serous meningitis, acute meningoencephalitis, acute viral meningitis) and bacterial (pneumococcal, meningococcal, TB, of unspecified etiology).

Of the 50 children investigated during the 3 years of study, 16 were girls and 34 were boys aged between 1 month and 16 years.

Analyzing the cases from 2021-2023 (Fig. 1), the predominant environment of origin of the investigated children was the rural environment. Thus, the following data were obtained:

- In 2021 in the urban (U) environment 33%; in rural (R) areas 67%;
- In 2022 in the urban environment 24%; in rural areas 76%;
- In 2023 in the urban environment 27%; in rural areas 73%.
- In boys, in 2021 bacterial forms predominated with 44%, in 2022 viral forms predominated (42%), and in 2023 there was an equivalence of cases.
- In girls in 2021, bacterial meningitis predominated by 28%; in 2022 and 2023 the

viral forms had similar percentages (23% and 27%, respectively).

- In 2021, the most bacterial meningitis was recorded, both among boys and girls (Fig. 2).
- Regarding the distribution of meningitis types, in 2022 and 2023 a higher percentage of viral forms was observed with percentages of 65% and 60%, and in 2014 bacterial forms predominated with a percentage of 72% (Fig. 3).

The cerebrospinal fluid of meningitis during the 3 years of study was clear, opalescent and hemorrhagic.

- The clear liquid recorded the highest percentages in both forms with 34% and 28%;
- The opalescent liquid had identical percentages of 14%;
- Hemorrhagic fluid had a smaller distribution during the 3 years of the study, in bacterial meningitis having a percentage of 8%. This is evident from the following graph (Fig. 4).

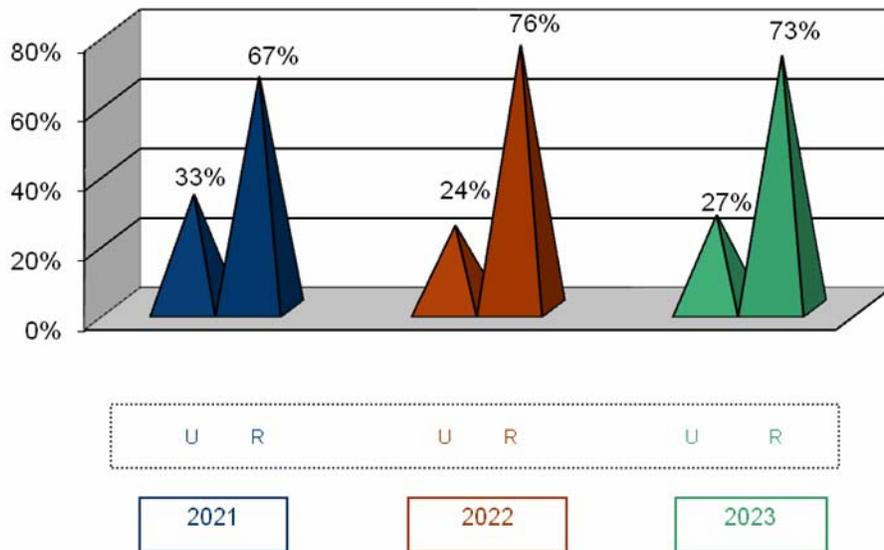


Fig. 1. Distribution according to the environment of origin

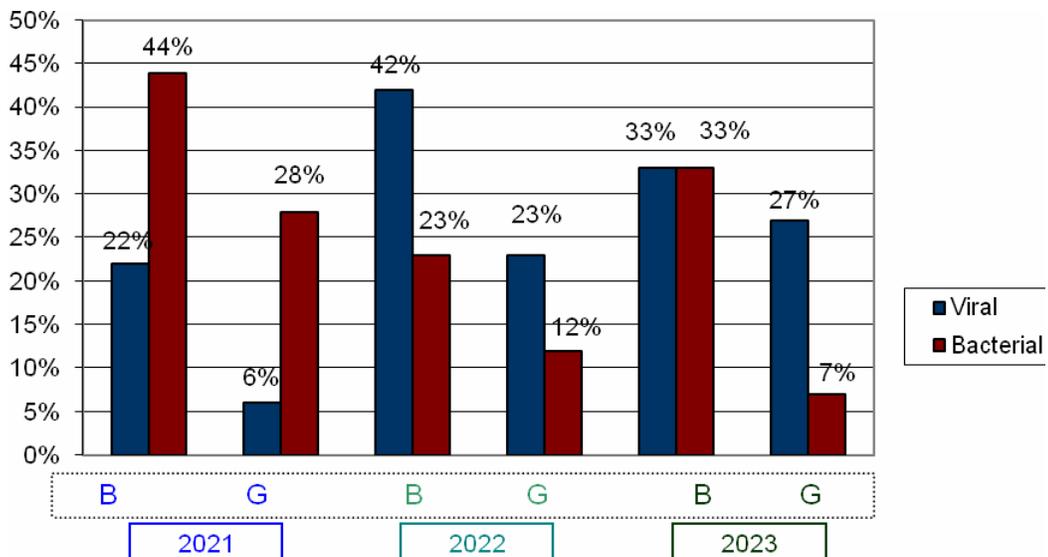


Fig. 2. Distribution of meningitis according to the gender of the children

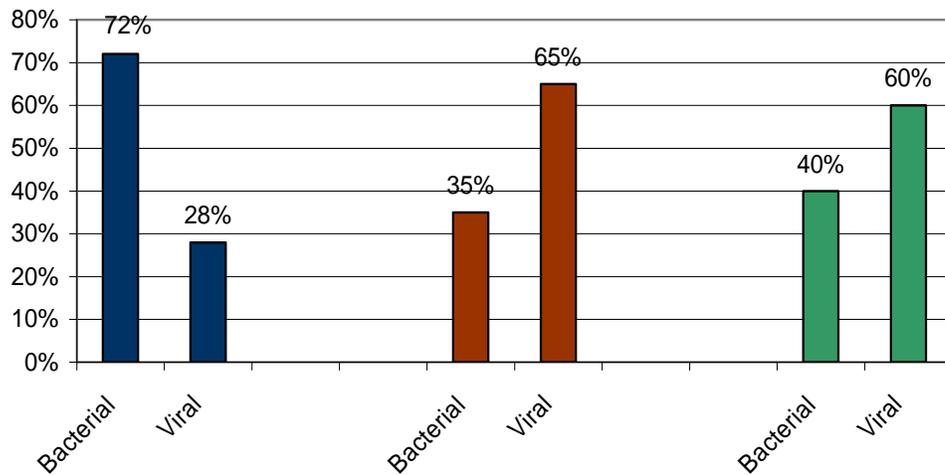


Fig. 3. Distribution of meningitis types

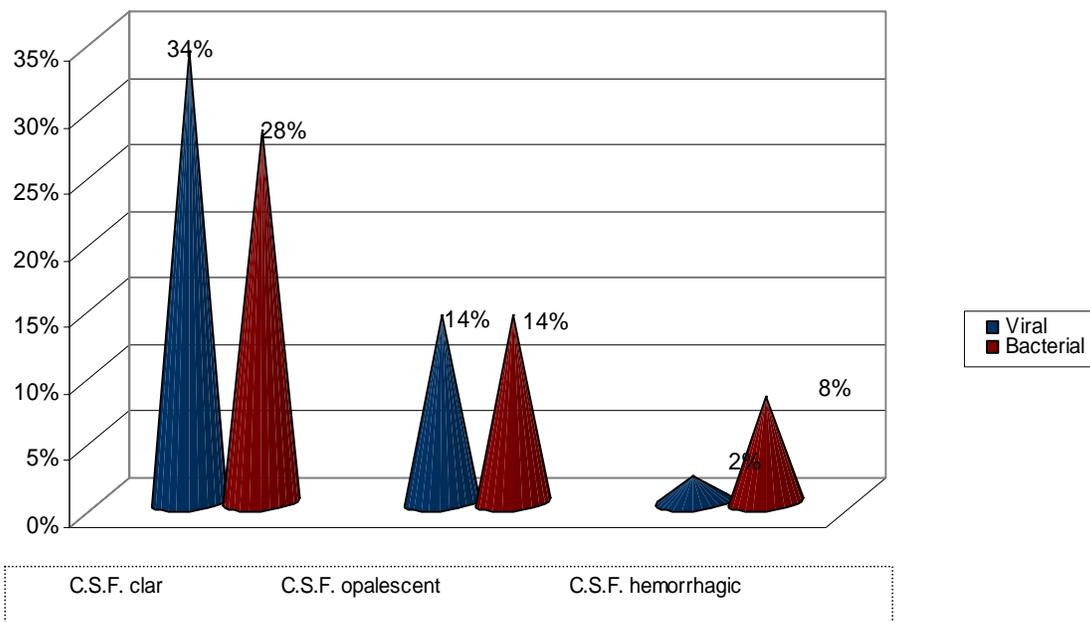


Fig. 4. Distribution of meningitis depending on the appearance of the cerebrospinal fluid

Regarding the distribution of meningitis according to age group, it can be said that in 2021 and 2022, the 0-2 year age group recorded the highest percentages of bacterial meningitis with percentages of 44.44% and 23.53% and in 2023 there was no case in this age group.

In the age group 3-6 years in 2023 there was a fairly high percentage of bacterial meningitis of

33.33% and the viral forms in the 3 years are less with percentages of 11.11%, 5.87%, 13.33%.

In the age group 7-16 years in 2022 and 2023, viral forms predominated with percentages of 35.29% and 26.67%, and the most bacterial forms were in 2021 with a percentage of 20%. The situation results from figures 5, 6 and 7.

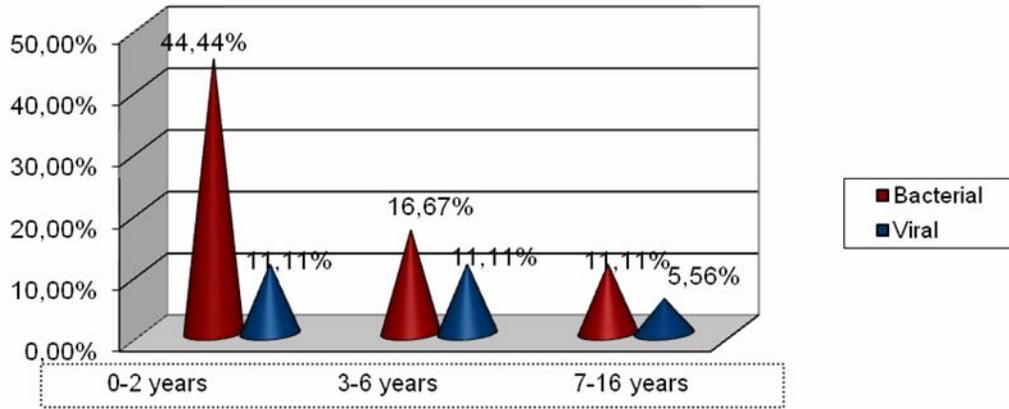


Fig. 5. Distribution of meningitis by age groups /2021

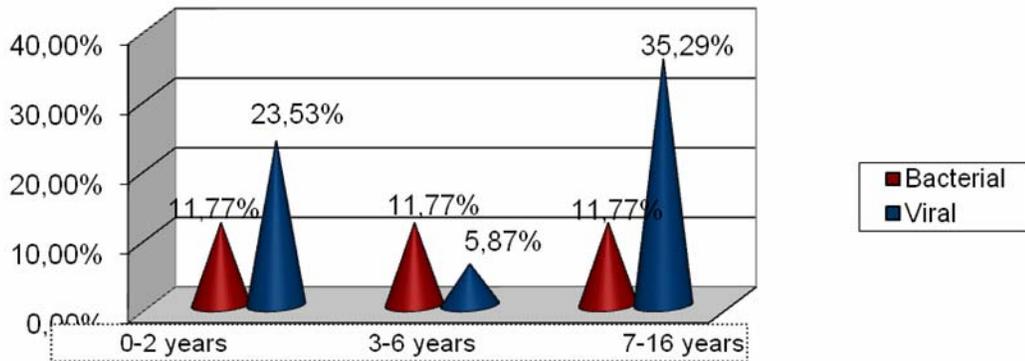


Fig. 6. Distribution of meningitis by age groups/ 2022

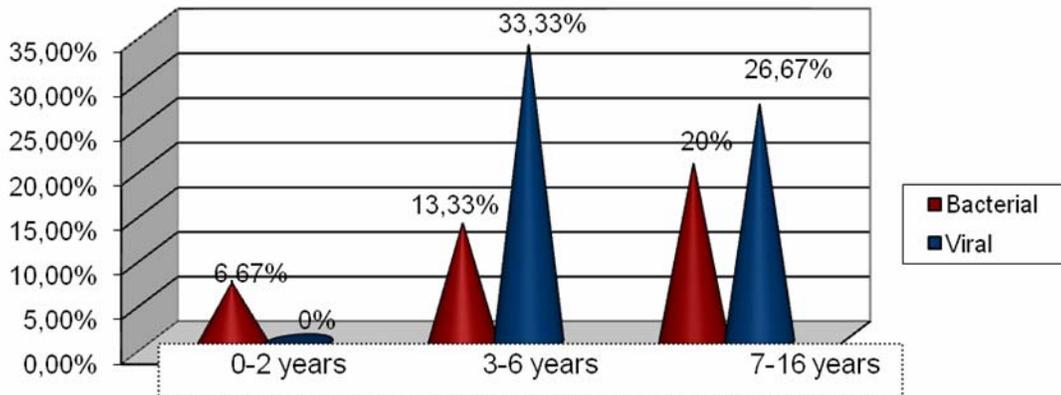


Fig. 7. Distribution of meningitis by age groups/ 2023

Cerebrospinal fluid with few elements was recorded in bacterial forms, namely, less than 10 elements in 2021 and 2022 (0% and, respectively, 33.33%) in 2023 only 20% and in viral forms there were relatively small percentages (in 2023 the lowest percentage is 10%).

Cerebrospinal fluid with 10-500 elements was predominant in 2021 with a percentage of 92% in bacterial forms and in viral forms in 2022 with 63.60%. Between 1200-5000 elements, bacterial meningitis had the highest percentage. The situation emerges from the following figures 8, 9 and 10.

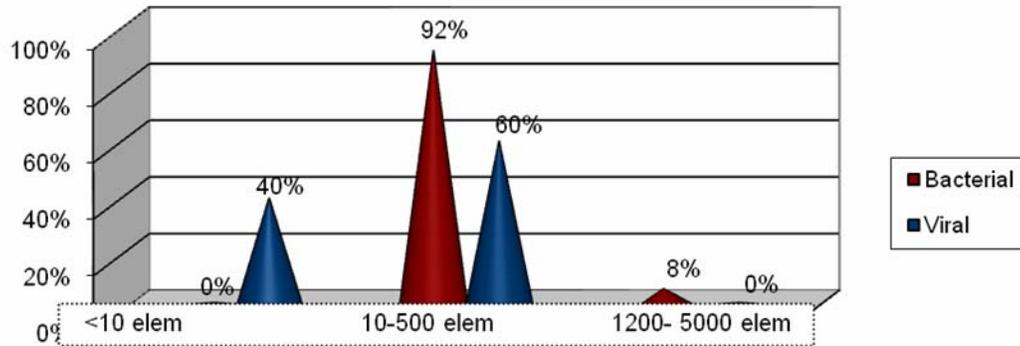


Fig. 8. Distribution of meningitis according to the number of elements/ 2021

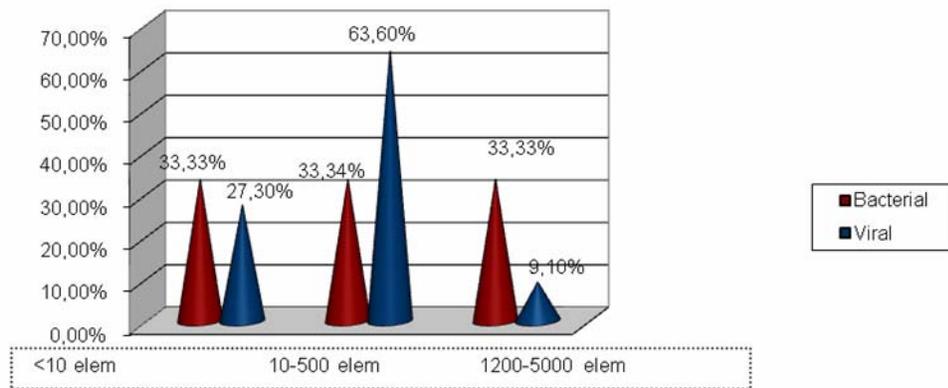


Fig. 9. Distribution of meningitis according to the number of elements/ 2022

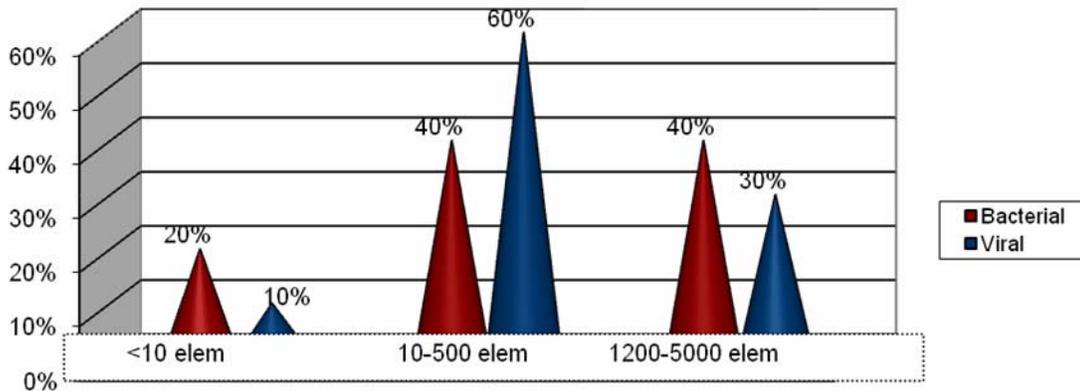


Fig. 10. Distribution of meningitis according to the number of elements/2023

In the 3 years of the study, the highest percentages of infections with pathogenic agents in bacterial meningitis had it (Fig. 11):

- 43% infections with Koch's bacillus;
- 36% meningococcal infections;

The study of the distribution of meningitis during the months of the 3 years of study shows that most children were prone to meningitis in the warm season, respectively spring and summer (Fig.12).

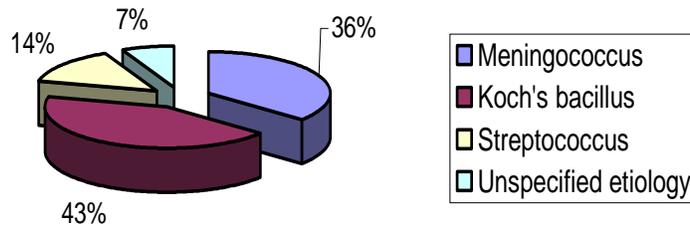


Fig. 11. The pathogen of bacterial meningitis during the 3 years of study

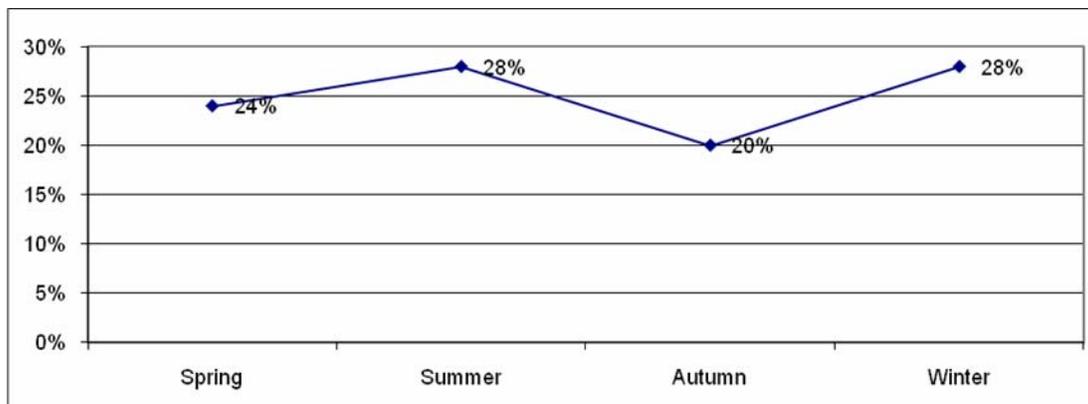


Fig.12. Seasonal distribution of meningitis in the 3 years of study

In the viral forms, the etiology is varied, but the pathogenic mechanisms are common, causing similar clinical symptoms and biochemical changes. The cerebrospinal fluid presents an identical appearance in all these diseases regardless of the pathogen that induced them.

Thus, the aspect of C.S.F. is clear or opalescent. Cellular elements are present in variable numbers from less than 10 elements/m³ to 5000 elements/m³. At first, some of these elements are polynuclear, but very quickly they appear mostly mononuclear: lymphocytes, monocytes, plasmocytes, giving the smear a polymorphous appearance, in contrast to tuberculous meningitis, where in a clear liquid we find a relatively small number of elements, several dozen to several hundred, mostly adult lymphocytes and very few (5-10%) polynuclear.

In viral meningitis, the microorganisms on the smears are absent and on the cultures they are negative, on the usual media. The changes in G.S.F. they consist of slightly increased proteinuria and glycouria and chloruria are close to the normal value.

In the bacterial forms, the liquid changes faithfully follow the clinical manifestations in their evolution and that is why the C.S.F. exam. it is of

great importance in order to establish the treatment strategy. Regardless of the nature of the pathogen (meningococcal, pneumococcal, or unspecified etiology) changes in C.S.F. are dominated by the neutrophil granulocyte, whose share approaches 100%. Cellular preparations frequently contain images of the bacteria that play the role of the etiological agent of the infection (meningococcus or pneumococcus).

Under the influence of antibiotic treatment, the number of cells, especially neutrophil granulocytes, decreases. Also, the number of elements/m³, in which immunologically competent cells (lymphocytes, mononuclear phagocytes) predominate.

The biochemical changes are obvious, they are the consequence of the alteration of the natural barrier systems in the central nervous system (CNS).

A marked hyperproteinorachia is also found, glucose and chlorides are low.

CONCLUSIONS

At the level of Bacău county, the most common meningitis were the bacterial forms that predominated with a percentage of 72% in 2021,

while the viral forms predominated in 2022 with a percentage of 65% and in 2023 with a percentage of 60% %.

Bacterial meningitis registered in the 3 years in Bacău county have as pathogen: Koch's bacillus 43%, meningococcus 36%, streptococcus 14%, unspecified etiology 7%.

In the bacterial forms, regardless of etiology, changes in L.C.R. they are the same. C.S.F. is clear, opalescent or hemorrhagic. Cytology is dominated by polymorphonuclear leukocytes reaching 100%. The biochemical changes are: hyperproteinorachia, up to 0 and hypochloruria.

In viral forms, although the etiology is viral, the C.S.F. changes, biochemistry and cytology are similar. Thus, C.S.F. is normal, clear, or slightly opalescent. Predominantly polymorphonuclear.

Proteinuria is significantly increased, while glycouria and chloruria are close to normal values.

ABSTRACT

18 cases from 2021, 17 cases from 2022 and 15 cases from 2023 were analyzed, in total 50 children, boys and girls. The following were recorded: the child's age, sex, environment of origin, the main biochemical parameters (amount of glucose, proteins, chlorine, number of elements, cytobacteriological parameters (normal or pathological cytology, presence of pathogens-meningococcus, pneumococcus, diplococcus) such as and the macroscopic appearance of the cerebrospinal fluid (color, transparency, appearance). The working methods were the classic ones (macroscopic, microscopic examination, Pandy reaction, culture on agarose gel, smear). In Bacău County, the most frequent meningitis were **the bacterial forms** that predominated with a percentage of 72% in 2021, while the viral forms predominated in 2022 with a percentage of 65% and in the year 2023 with a percentage of 60%. Bacterial meningitis registered in the 3 years at the level of Bacău County have as pathogens: Koch's bacillus 43%, meningococcus 36%, streptococcus 14%, unspecified etiology 7%. In bacterial forms, regardless of etiology, changes in C.S.F. they are the same. C.S.F. is clear, opalescent or hemorrhagic. Cytology is dominated by polymorphonuclear leukocytes reaching 100%. The biochemical changes are: hyperproteinorachia, up to 0 and hypochloruria. **In viral forms**, although the etiology is viral, the C.S.F. changes, biochemistry and cytology are similar. Thus, C.S.F. is normal, clear, or slightly opalescent. Predominantly polymorphonuclear.

REFERENCES

1. ARSENI C., CRĂCIUN E.C., CSIKY C., DRĂĂNESCU ST., ESKENSAY AL., GYERGYAY FR. et al, 1957 -

Morphopathology of the nervous system (Morfopatologia sistemului nervos), Medical Ed., Bucharest.

2. ARSENI C., 1979 - Treatise on neurology (Tratat de neurologie), Medical Ed., Bucharest.
3. BALȘ M., The clinical laboratory in infections (Laboratorul clinic în infecții), Medical Ed., Bucharest, 1982.
4. CĂRUNTU VERONICA AND CĂRUNTU F., 1979 - Vademecum of infectious diseases (Vademecum de boli infecțioase), Medical Ed., Bucharest.
5. CEZAR I., 1982 - Neurology Compendium (Compendium de neurologie), Medical Ed., Bucharest.
6. DOGARU D., 1982 - Infectious diseases (Boli infecțioase), Didactic and Pedagogical Ed., Bucharest.
7. GRAY, H., , 1977 - "Gray's anatomy", Gramercy books, New York.
8. McCracken, Th., , 1993 - "New atlas of human anatomy", Ed. Aquila, Oradea.
9. MOLL, K.J., MOLL, MICHAELA, , 1997 - "Atlas of anatomy", Ed. All, Bucharest.
10. PREDESCU I., TAINDEL C., 1971 - Meningitis and acute encephalitis (Meningite și encefalite acute), Medical Ed., Bucharest.
11. PRISECARU MARIA, IONUȚ STOICA, 2017 - General and clinical immunology (Imunologie generală și clinică), Ed. Alma Mater Bacău, ISBN 978-606-527-572-0
12. PRISECARU MARIA, IONUȚ STOICA, 2017 - Medical Microbiology (Microbiologie medicală), Ed. Alma Mater Bacău, ISBN 978-606-527-541-6
13. PRISECARU MARIA, IONUȚ STOICA, DUMITRA RĂDUCANU, 2015 - General microbiology (Microbiologie generală), Ed. Alma Mater Bacau, ISBN 978-606-527-466-2.
14. PRISECARU MARIA, IONUȚ STOICA. DANIELA TIȚĂ, FLORIAN PRISECARU. 2020 - Health education guide and human pathology, vol. II, Mother and child health (Ghid de educație pentru sănătate și de patologie umană, vol. II, Sănătatea mamei și a copilului), Ed. Alma Mater Bacău, ISBN 978-606-527-657-4
15. PRISECARU MARIA, IONUȚ STOICA. DANIELA TIȚĂ, FLORIAN PRISECARU, 2021 - Health education guide and human pathology, vol. III, Diseases of different organs and systems (Ghid de educație pentru sănătate și de patologie umană, vol. III, Bolile diferitelor organe și sisteme), Ed. Alma Mater Bacău., ISBN 978-606-527-663-5
16. PRISECARU MARIA, IONUȚ STOICA. DANIELA TIȚĂ, FLORIAN PRISECARU, 2021 - Education guide for health and human pathology, vol. IV, Health and the challenges of the contemporary world (Ghid de educație

- pentru sănătate și de patologie umană, vol. IV, Sănătatea și provocările lumii contemporane), Ed. Alma Mater Bacău., ISBN 978-606-527-664-2
17. RĂDUCANU DUMITRA, PRISECARU MARIA, 2016 - General microbiology: guide for practical work (Microbiologie generală: ghid pentru lucrări practice) – Ed. Alma Mater Bacău, ISBN 978-606-527-532-4.
 18. SUNDAY OF AND BOCÂRNEA C., 1983 - Infectious diseases-practical guide (Boli infecțioase-ghid practic), Medical Ed., Bucharest.
 19. VOICULESCU M., 1981 - Infectious diseases (Boli infecțioase), Medical Ed., Bucharest.

AUTHORS`ADRESS

STOICA IONUȚ, RĂDUCANU DUMITRA, PRISECARU MARIA – „Vasile Alecsandri” University of Bacau, Faculty of Science, Department of Biology, Marasesti Street, No 157, Bacau, Romania, e-mail:

ionut_stoica23@yahoo.com;
dumitra_manea@yahoo.com;
prisecaru_maria@yahoo.com

TIȚĂ DANIELA - County Emergency Hospital Bacau St. Spiru Haret, no.2-4, Bacau, Romania, e-mail address:

danielatita2007@yahoo.com

Corresponding author's:

prisecaru_maria@yahoo.com