

## CYTOLOGY OF CEREBROSPINAL FLUID (CSF) IN MENINGITIS

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**Key words:** CSF, bacterial and viral meningitis, morphological, cytological, bacteriological examination

### INTRODUCTION

Bacterial meningitis is inflammation of the membranes lining the leptomeninges, caused by various pyogenic bacteria and characterized by the presence of polymorphonuclear leukocytes in the cerebrospinal fluid.

Viral meningitis is caused by viruses that enter the mucous membranes: intestinal, pharyngeal, nasopharyngeal, through the skin, due to the sting of infected insects.

It multiplies at the entrance gate, then enters the bloodstream and acts through their toxins on the central nervous system, producing meningitis, meningoencephalitis.

Meningitis is one of the medical emergencies, its etiology being complex, and therapy should be applied as soon as the diagnosis is established. These diseases can lead to an increased mortality rate and severe sequelae that occur in the absence of proper treatment.

The aim of this paper is to show the importance of studying **cerebrospinal fluid (CSF)**, to determine as soon as possible the etiological agents involved in the pathology of meningitis and to provide as quickly and accurately as possible the decisive information in establishing the clinical diagnosis in a patient with meningitis. its.

### MATERIAL AND METHODS

In the Medical Analysis Laboratory S.C. Medcenter S.R.L., which serves the Bacău County Emergency Hospital, between 01.01.2019 until 31.12.2021, 50 subjects with the diagnosis of meningitis, children and adults were analyzed, distributed as follows: in 2019 -15 cases, in 2020- 18 cases and in 2021 - 17 cases.

The study aims to establish the percentage of cases by: the sex of patients, by the environment of origin of patients, by the types of meningitis, by the appearance of CSF, by the number of elements, by the pathogen that produced bacterial meningitis in the 3 years of study.

In the Clinical Medical Analysis Laboratory of S.C. Medcenter S.R.L. the following CSF determinations were performed:

- **Macroscopic examination** - appearance of the liquid (transparency, color, fluidity) - fig. 1.

- **Cytological examination** - determination of the number of elements / mm<sup>3</sup> - using the Fuchs-Rosenthal counting chamber. The quantitative cytological examination was performed, respectively the counting of the suspended elements and the determination of the type of cells in the liquid. The counting of the elements was performed on the non-centrifuged liquid and was expressed in number of elements / mm<sup>3</sup>.

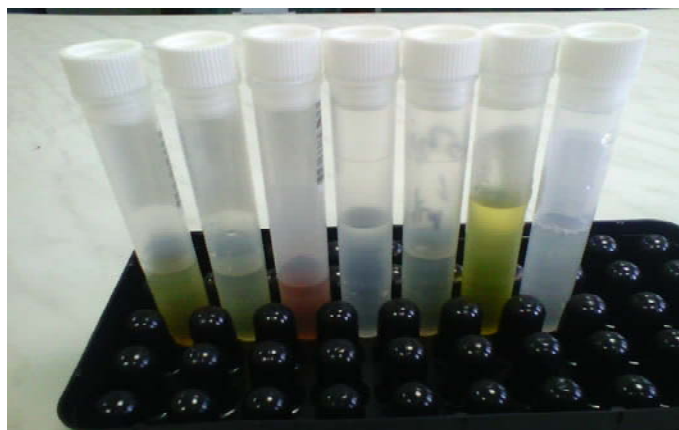


Fig. 1. CSF tests with different aspects

#### Calculation formula:

$$\text{Nr. items} = \text{Nr. numbered cells} * \text{dilution} /$$

3,

where the dilution may be 1/2, 1/5, 1/10, 1/15, 1/20, or more, depending on the opalescence of the liquid, sometimes may be purulent (may contain an increased number of leukocytes), hemorrhagic increased red blood cell count);

3 = represents the height of the Fuchs Rosenthal counting chamber.

*Qualitative cytological examination* was performed from the sediment on smears which were subjected to microscopic examination.

Three smears were obtained as follows: Gram, May Grunwald Giemsa, methylene blue. On the Giemsa colored slide, the cytological examination was performed (the type of elements was assessed as a percentage: PMN, lymphocytes, monocytes, macrophages). The Gram stained smear captured the morphological appearance of the etiological agents.

• **Bacteriological examination** was performed on cultures, antibiogram, smear. Sowing was done on agar-blood medium; for the antibiogram, the method used is the diffusimetric one on nutrient agar plates (Müller-Hinton medium) on which the discs (microcompresses) with different antibiotics were applied.

## RESULTS AND DISCUSSIONS

All 50 patients investigated in the 3 years of study were diagnosed with meningitis of different etiologies: viral (serous meningitis, acute serous meningitis, acute meningoencephalitis, acute viral meningitis), bacterial (meningococcal,

pneumococcal, TB, staphylococcal, streptococcal). other bacteria), fungal and an iatrogenic case.

Of the 50 patients, 18 were female and 32 were male, aged between 5 days and 82 years.

According to the background of the patients investigated in the three years of study, 2019-2021, the predominant environment was rural. According to this criterion, the following data were obtained (fig. 1):

In 2019 in the urban area 33%; in rural areas 67%;

In 2020 in the urban environment 39%; in rural areas 61%;

In 2021 in the urban environment 29%; in rural areas 71%.

According to the sex of the people investigated in this study, meningitis was distributed over the 3 years, as follows:

In men, in 2019, bacterial forms predominated with a percentage of 80%, 20% being occupied by viral forms; in 2020 there was an equivalence of 50% bacterial forms and 50% viral forms, and in 2021 the bacterial forms predominated in 60%, 30% viral forms and 10% of iatrogenic meningitis.

In women, in 2019, viral meningitis predominated in a percentage of 60%, 20% bacterial meningitis and 20% fungal meningitis; in 2020, bacterial meningitis predominated by 50%, viral meningitis by 33% and false meningitis by 17%; in 2021 they dominated the viral forms in a percentage of 57%, 29% occupied the bacterial meningitis and a percentage of 14% the fungal meningitis.

In 2019, the most cases of bacterial meningitis were registered, both among men (M) and women (W), figures 2, 3.

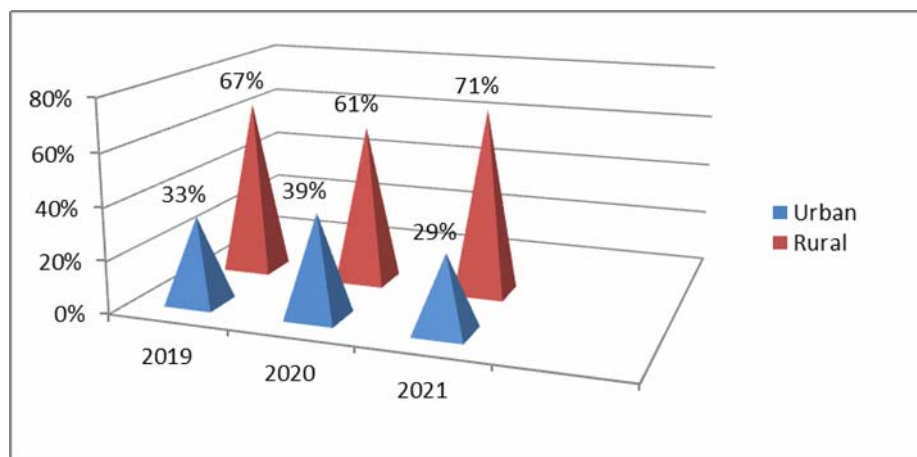


Fig. 1. Distribution of patients studied depending on the environment of origin

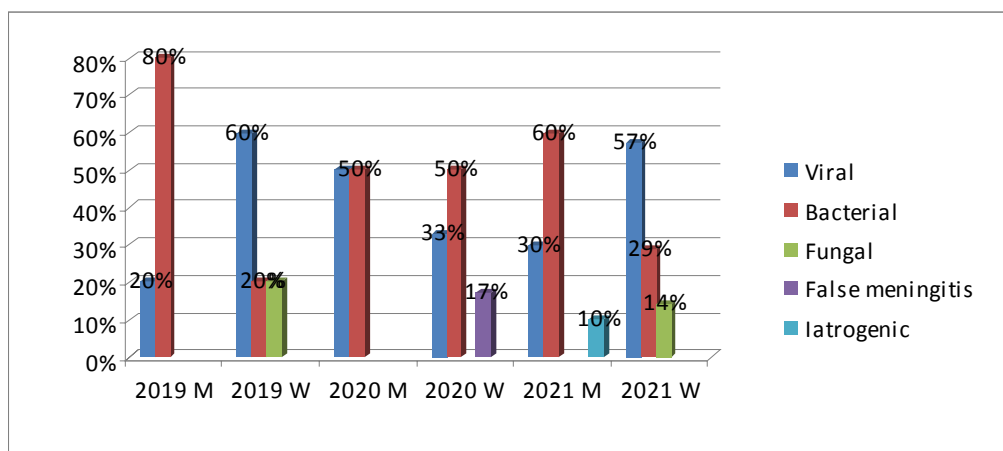


Fig. 2. Distribution of meningitis according to patient sex

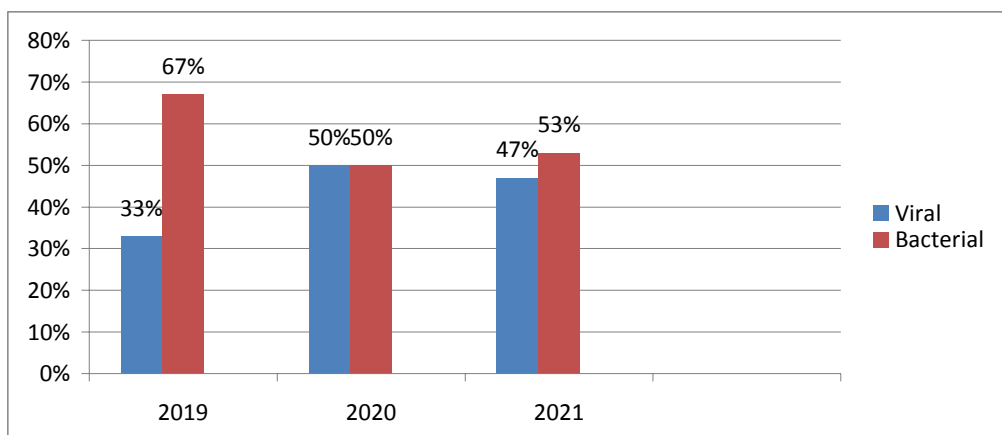


Fig. 3. Distribution of types of meningitis

The appearance of the cerebrospinal fluid studied during the 3 years of study was clear, opalescent and hemorrhagic (Fig. 4).

The opalescent liquid recorded the highest percentages in the bacterial form, respectively 36% and 2% in the viral forms;

The clear liquid had identical percentages of 32% in the viral forms, and in the bacterial forms 22%;

The hemorrhagic fluid had a lower distribution in the 3 years of study, 6% in viral forms, in bacterial meningitis having a percentage of 2%.

Regarding the distribution of meningitis according to the age group (figures 5, 6, 7) it can be said that in 2019 and 2021 in the age group 19 - 64 years the highest percentages of bacterial meningitis were recorded with percentages of 26.66% and

23.52%, and in 2020 in this age category the percentage was lower 13.33%. A high percentage of bacterial meningitis also has the group 0 -2 years in 2019, with a percentage of 19.99%, followed by a descendant of the group 7-18 years in 2021 in a percentage of 17.64%. An important percentage of bacterial meningitis is also occupied by the age group 3-6 years from 2020 with a percentage of 16.66%.

The predominance of viral forms is found in the age group 7-18 years in 2020 in a percentage of 20.82%, followed by the group 0-2 years in 2021, with a percentage of 17.64%, favored by groups 3-6 years and over 65 who in 2021 have no cases of viral meningitis.

In 2021 there is also a case of iatrogenic meningitis (of medicinal etiology).

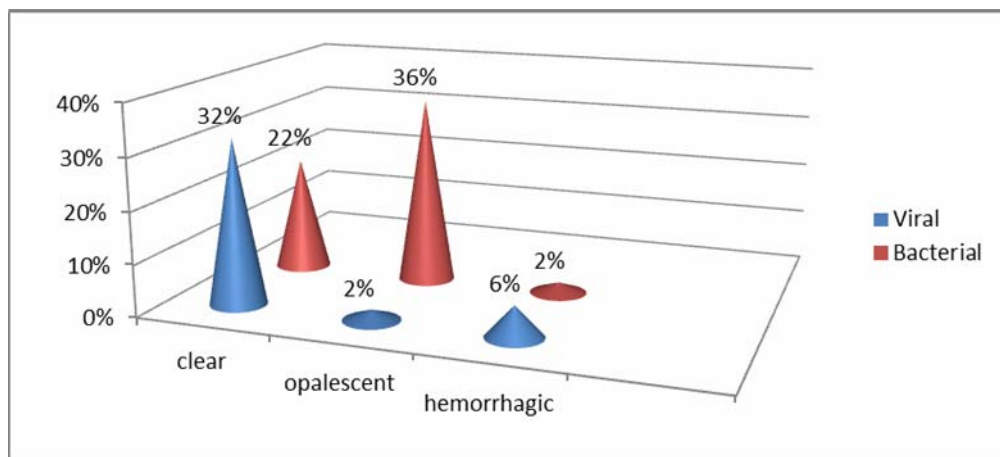


Fig. 4. The distribution of meningitis according to the appearance of CSF

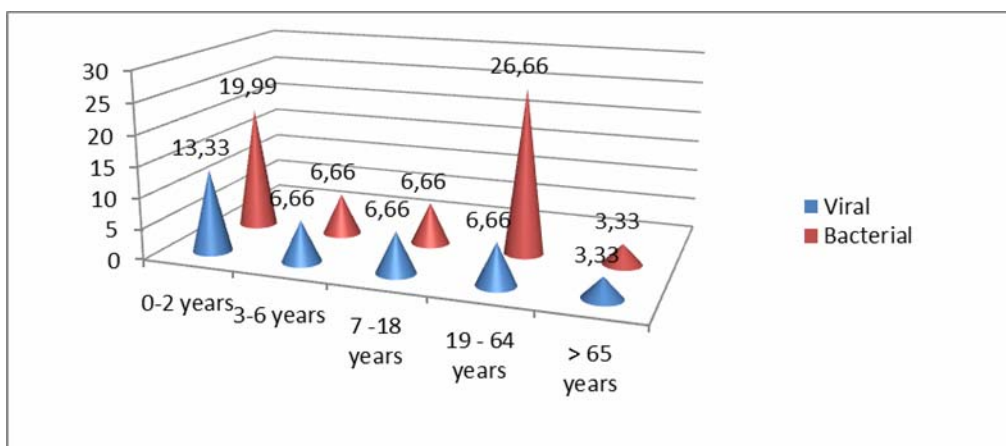


Fig. 5. Percentage distribution of meningitis by age groups 2019

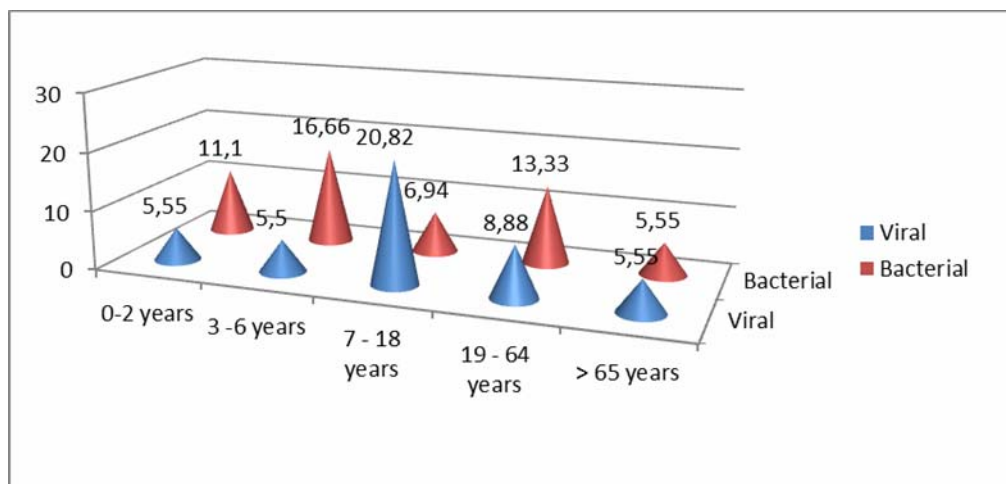


Fig. 6. Percentage distribution of meningitis by age groups 2020

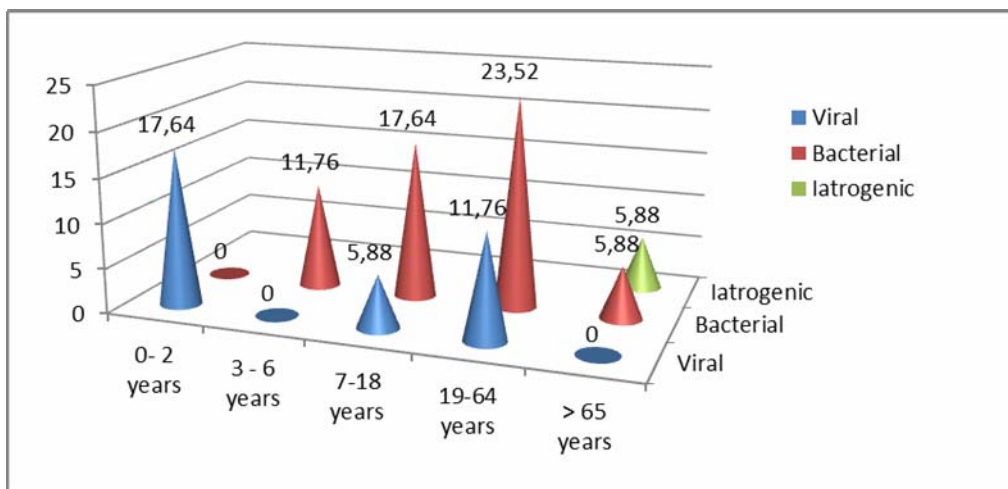


Fig. 7. Percentage distribution of meningitis by age groups 2021

The number of elements / mmc in the 3 years was determined by the categories: <10 elements / mmc, between 10-500 elements / mmc, from 501-1000 elements / mmc and the cases of viral and bacterial meningitis that have over 1001 up to 5000 elements / mmc (figures 8, 9, 10).

In the category with less than 10 elements / mmc, in the bacterial forms of L.C.R., in the studied cases, they were absent. The share of bacterial meningitis in this studied criterion is held in the category 10-500 elements / mmc, dominant for all the years studied: in the first place the year 2019 with a percentage of 39.96%, followed by the year 2020 in a percentage of 38.85%, and the last 2021, with 29.4%. Bacterial meningitis is missing in the category 501-1000 elements / mmc in the years 2019 and 2020, in 2021 they have a percentage of 11.76%. Bacterial meningitis in the last studied category, between 2001-5000 elements / mmc predominates in 2019 with a percentage of 20%, in 2020 they have 5.55% and in 2021 the percentage is 5.88%. Viral forms with less than 10 elements / mmc have the following

percentage: 6.66% in 2019, 5.55% in 2020, 11.76% in 2021. Viral meningitis has a high percentage in the category 10-500 elements / mmc in all the years studied, thus, the year 2020 is the series leader with a percentage of 44.44%, followed by the year 2021 with 41.17% and the year 2019 with 33.33%. Viral forms are missing in the categories 501-1000 elements / mmc in 2019 and 2021, and in the category 1001-5000 elements / mmc, viral meningitis is missing in all years of study.

Regarding the etiological agent of meningitis identified in the 3 years of study, the situation is as follows: the share is held by viral causes with a higher percentage than other types of etiological agents, respectively 36%, succeeded by meningococcus (*Neisseria meningitidis*) by 16%, the second place being the unspecified causes, in a percentage of 10%; Pneumococcus and Koch's bacillus equal to 8%. Staphylococcus causes 6% of bacterial meningitis. A percentage of 4% belongs to each of the following: streptococcus, E. coli, H. influenzae and fungi (fig. 11).

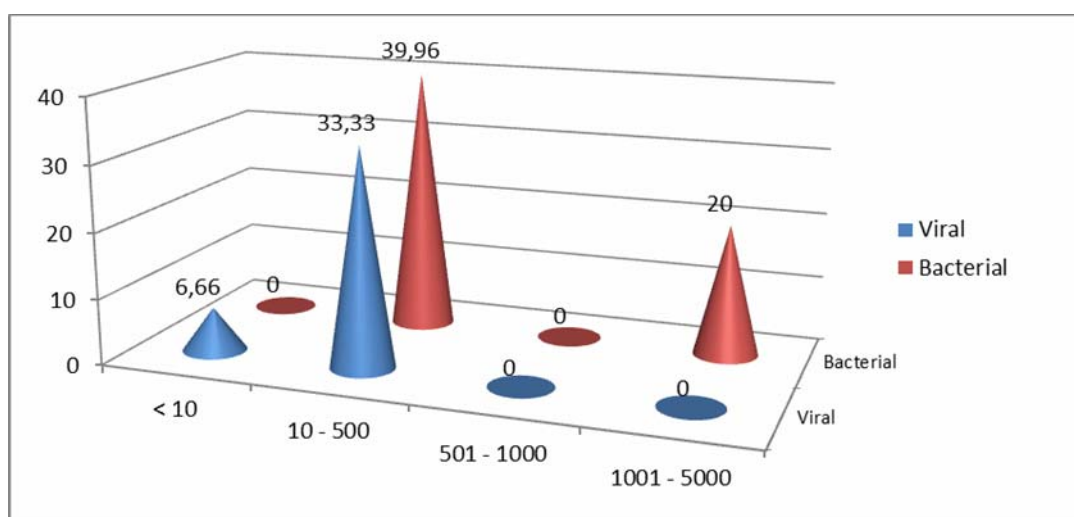


Fig. 8. Distribution of meningitis according to the number of elements 2019

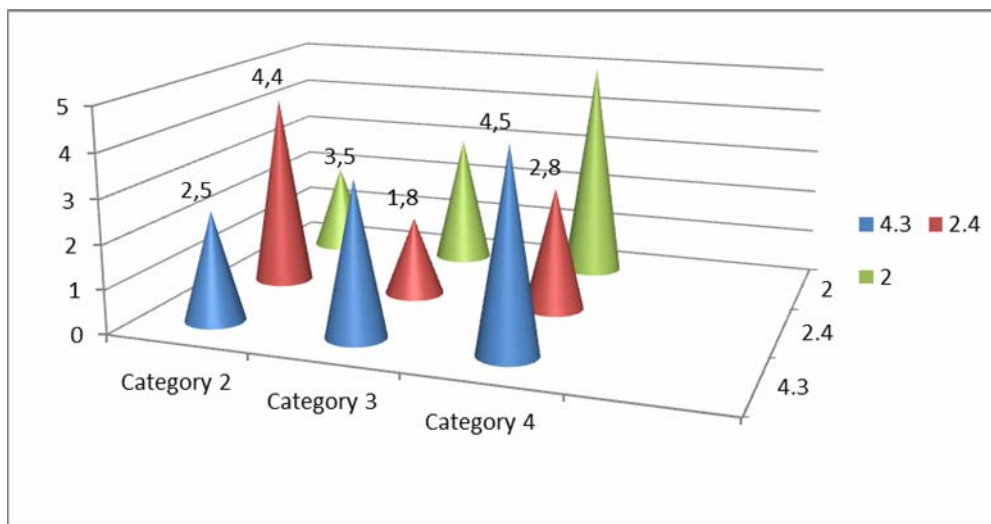


Fig. 9. Distribution of meningitis according to the number of elements 2020

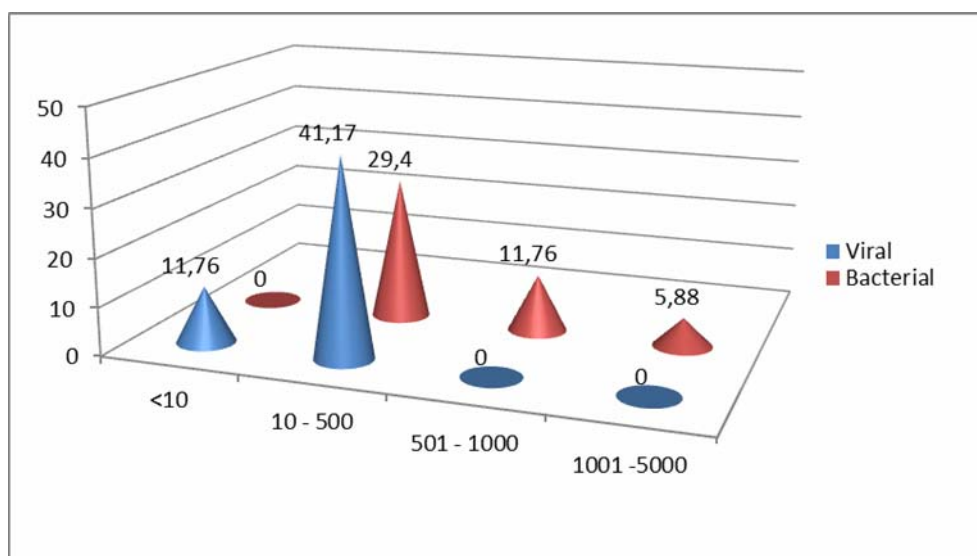


Fig. 10. Distribution of meningitis according to the number of elements 2021

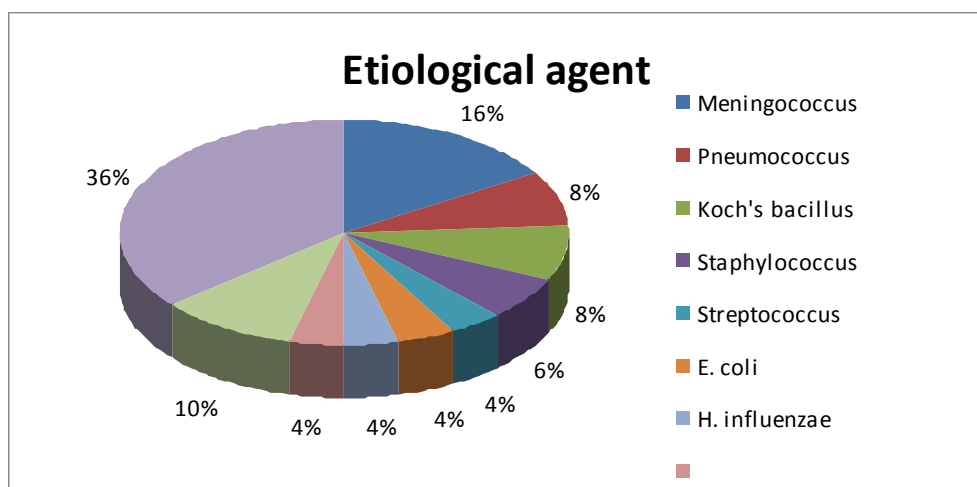


Fig. 11. The etiological agent of meningitis investigated in the 3 years of study

## CONCLUSIONS

CSF cytology is a valuable laboratory analysis along with other biochemical and microbiological determinations, which come to the aid of the clinician who can thus establish the appropriate medication, targeted at the etiological agent of meningitis, one of the greatest medical emergencies.

At the level of Bacău county, the most frequent diseases were the viral forms with a percentage of 36% in the three years of study. But if we add up all the forms of bacterial meningitis regardless of the etiological agent that produced them, they predominate in a percentage of 50%.

In bacterial meningitis, regardless of etiology, CSF they are the same. The appearance of CSF it is predominantly opalescent. Cytology is characteristic, polymorphonuclear predominates (> 1000 elements / mmc).

In viral forms, changes in CSF, biochemistry, and cytology are similar to bacterial ones, although the etiology is viral. The appearance of CSF it is normal, clear colorless, rarely slightly opalescent. In the cytological examination, lymphocytes predominate (500-1000 / mmc).

TB meningitis is characterized by the presence in the bacterioscopic examination of acid-alcohol-resistant bacilli (BAAR), which are highlighted on the Ziehl-Neelsen stained smear (it turns red on a blue background), and in cultures the presence of *Mycobacterium tuberculosis* can be observed. by sowing on Lowenstein Jensen enrichment medium.

The bacterial meningitis registered in the 3 years at the level of Bacău county has as etiological agent: meningococcus 16%, Koch bacillus 8%, pneumococcus 8%, staphylococcus 6%, streptococcus 4%, E. coli 4%, H. influenzae 4%.

Fungal meningitis, caused by *Cryptococcus* sp. they are rare and occur in the immunocompromised host, in HIV patients in medical history.

## ABSTRACT

Between 01.01.2019 and 31.12.2021, 50 subjects with meningitis of different etiologies from the Bacău County Emergency Hospital were analyzed. The study was conducted at the S.C. Medcenter S.R.L. Medical Analysis Laboratory, which serves the hospital. All 50 patients investigated in the 3 years of study were diagnosed with meningitis: viral (serous meningitis, acute serous meningitis, acute meningoencephalitis, acute viral meningitis), bacterial (meningococcal, pneumococcal, TB, staphylococcal, streptococcal and other bacteria), fungal and an iatrogenic case. In bacterial meningitis cytology is characteristic, polymorphonuclear predominates (> 1000 elements / mmc). TB meningitis is characterized by the presence in the bacterioscopic examination of acid-

alcohol-resistant bacilli (BAAR), which are highlighted on the Ziehl-Neelsen stained smear (it turns red on a blue background), and in cultures the presence of *Mycobacterium tuberculosis*. In viral forms, cytological examination shows the predominance of lymphocytes (500-1000 / mmc). The bacterial meningitis registered in the 3 years at the level of Bacău county has as etiological agent: meningococcus 16%, Koch bacillus 8%, pneumococcus 8%, staphylococcus 6%, streptococcus 4%, E. coli 4%, H. influenzae 4%. At the level of Bacău county, the viral forms had a share of 36% in the three years of study, but the bacterial meningitis, regardless of the etiological agent that produced them, were predominant (50%).

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