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SYSTEMIC ANALYSIS OF THE PROBLEM
„PATHOPHYSIOLOGICAL MECHANISMS OF
DEVELOPMENT OF BRAIN EDEMA”

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The problem of pathophysiological mechanisms of the development of brain edema, as is probably the case with every modern biomedical problem, has become very complicated. The study of these mechanisms entails accounting for a great variety of processes, which requires the application of a spectrum of quite different methods pertaining to different fields of biomedical science. Furthermore, this field of research, as the modern biomedical science in general, is characterized by a progressive compartmentalization of interests of individual researchers whose topics of study are getting more and more specific and who become experts in gradually narrower areas. Consequently, the world's scientific periodicals each year bring an enormous amount of specialized information and fragmentary data, and it is becoming more and more difficult, even for experienced scientist, to digest and properly synthesize all the accruing knowledge.

Obviously, various mechanisms and processes of the development of brain edema actually do not operate independently of each other. After being artificially separated and fractioned for legitimate reasons of scientific analysis, they have therefore, to be eventually synthesized. Individual researchers have certainly to keep in mind that the mechanisms and processes under discussion are interrelated, even though they may belong to different fields of biomedical science. Remembering this obvious truth will, for sure, facilitate a better understanding of both a particular problem under investigation and factors that may affect the processes involved under natural conditions.

The situation becomes even more difficult when investigation of particular phenomena involved in the mechanism of the development of brain edema

requires the application of different methods belonging to different fields of biomedical research, making it necessary to seek information and contribution from many laboratories that may happen to be located at different institutions situated in different cities, countries, or even continents. To solve the problem of brain edema, and any other modern biomedical problem for that matter, efficient coordination of research is therefore needed.

For elucidation of complicated processes in living organisms functional diagrams began to be used by researchers already long ago. In functional diagrams both individual processes and their interconnections are shown. However, they are very often not well accounted for and thus there is usually a great variety of opinions concerning them, so it is difficult to design functional diagrams which would command an agreement among the majority of researchers. Thus, attempts to apply such diagrams for consideration of a given scientific problem as a whole frequently become futile.

The situation may be improved and research organization difficulties overcome if a systemic analysis is applied to the problem at hand and further used for gaining insight into its nature. Systemic analysis in this case means finding out all the subproblems making up the whole problem and attained in order that the subproblem can be solved. Finding connections among the topics at issue should not prove difficult, for in our case they are not likely to coincide with the already determined links functioning under present conditions. Furthermore, it would be much easier in this way to understand to which subproblems or objectives the topic under investigation belongs. In addition, on the basis of systemic analysis it would be easier to determine what studies are to be carried out for a better understanding of the most important points of the problem under investigation.

The authors intend to carry out the systemic analysis of the problem of pathophysiological mechanisms of the development of brain edema using the experience already accumulated by one of them, over the last five years as a result of analyzing in this way mechanisms of cerebral ischemia and mechanisms of regulation of the cerebral blood supply (Mchedlishvili, 1977; Mchedlishvili, Babunashvili, 1978).

At the initial stage a general graph of the problem under consideration has been plotted to specify all of its main constituents (i.e. the subproblems) to be elucidated for the solution of the whole problem (Fig. 1). The problem we are considering, i.e. pathophysiological mechanisms of the development of brain edema, is indicated in the upper block. In the other blocks placed below (1,0, 2,0 and 3,0) the subordinated constitutive problems (subproblems) are listed. The arrows show subproblems to be settled to reach the overall solution of the problem as a whole. The specification of the subproblems is primarily based on the following principles: a) anatomical point, i.e. the localization of the processes in the physiological system of the organism,

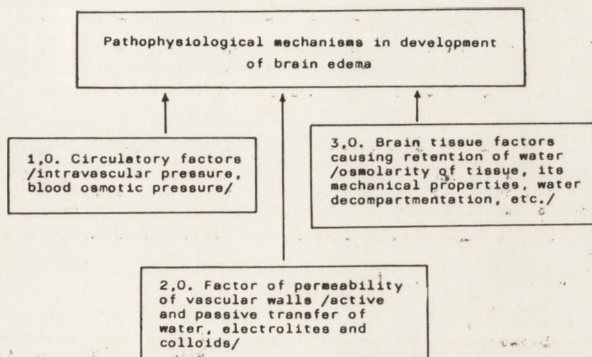


Fig. 1. Graph of the problem „Pathophysiological mechanisms in development of brain edema”.

Ryc. 1. Wykres do problemu „Mechanizmy patofizjologiczne w rozwoju obrzęku mózgu”.

b) functional point, i.e. the character of the processes and, in particular, the specificity of methods to be used for their study

The graph of the problem could be certainly detailed to a considerable extent. However, this has to be done rationally. Superfluously detailed graphs of problems are unnecessary since excessive fractionation of subproblems hinders the advancement in better understanding, discussing, as well as carrying out further research

Graphs of problems are in principle similar to decision graphs of problems. Graphs of problems bear similarity to functional diagrams which are often designed for a visual representation of interrelations which, for example, determine regulation of functions in the organism, or development of some pathological processes. However, there is a substantial difference between the two. Though, in both cases, there are arrows showing the cause and effect relations, in graphs of problems they indicate only the subproblems to be investigated to reach the solution of the respective problems, or subproblems of the upper level. In addition, in graphs of problems, unlike functional diagrams, the sequence of the links functioning under real conditions, i.e. the order in which individual subproblems are to be studied, is insignificant.

A further stage of the systemic analysis of the problem under discussion consists in plotting the graphs of objectives for each subproblem where the individual objectives are enumerated which are to be settled for the solution of the respective subproblems (Figs, 2, 3, 4). When plotting such graphs it has to be ignored how the objectives should be settled and particularly what methods are to be used for their solution, and the like. It should be sufficient at this stage to enumerate a possibly complete set of the objectives for each subproblem.

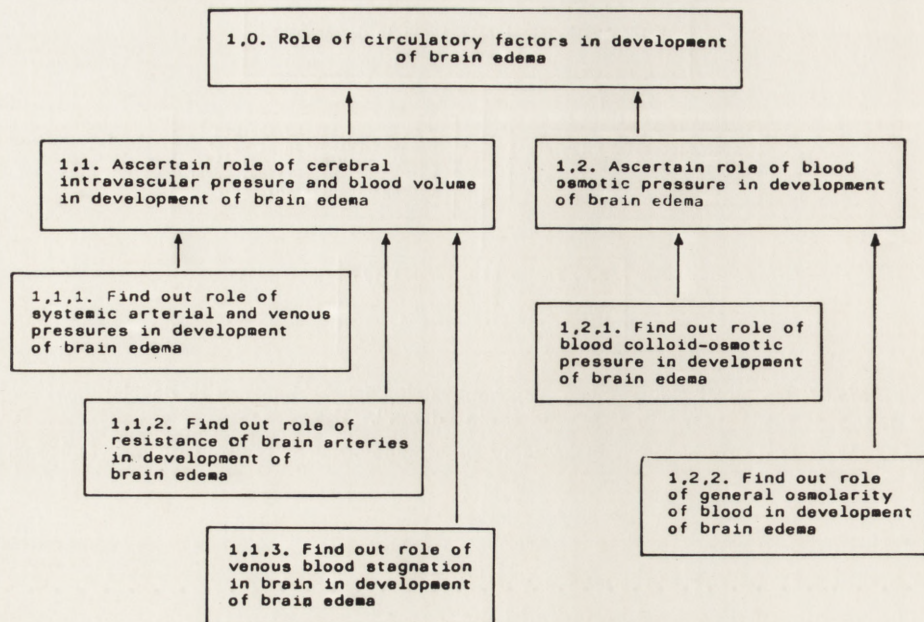


Fig. 2. Graph of the objectives for subproblem 1,0 „Role of circulatory factors in the development of brain edema”.

Ryc. 2. Wykres zadań w podproblemie 1,0 „Rola czynników krążeniowych w rozwoju obrzęku mózgu”.

In the following stages of the investigation of the problem under consideration and accumulation of the data for further specification of the graphs will certainly be required; this too, will entail program corrections. For this purpose systematic contact among the coordinators of the investigation are necessary, as well as their contact with other experts who would appraise how the research is carried out.

As soon as the graphs of the problem and the objectives have been considered proper and accepted as an outline for further research, graphs of tasks are to be composed for each objective separately. These graphs should include all the tasks which are to be carried out, but, unlike graphs of problems and graphs of objectives, they should show the sequence of performing the tasks in question. They should contain the following information (adequately detailed): a) what methods are to be used and what experiments are to be carried out; b) what equipment and what number of experimental animals are needed; c) how many and what kind of researchers should participate in the experiments.

Graphs of tasks make it possible to determine personnel, finances and material required for the intended investigations.

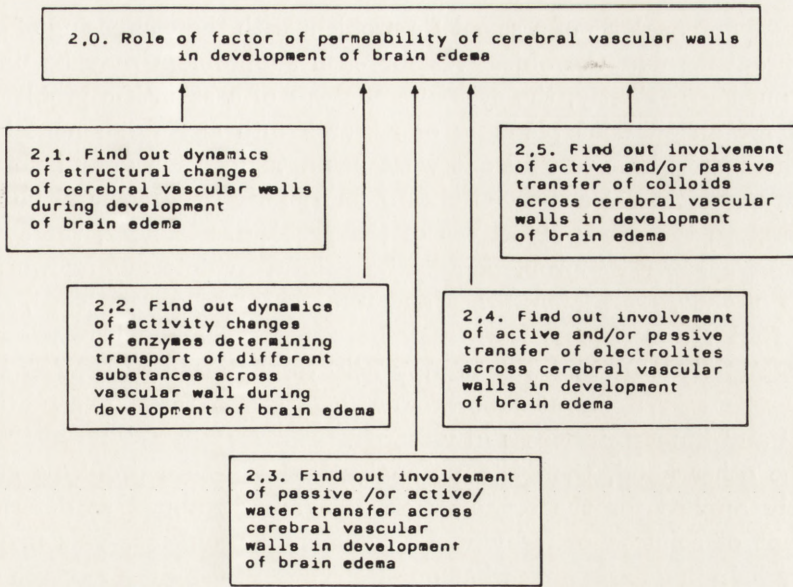


Fig. 3. Graph of objectives for the subproblem 2,0 „Role of the factor of permeability of the cerebral vascular walls in the development of brain edema”.

Ryc. 3. Wykres zadań w podproblemie 2,0 „Rola czynnika przepuszczalności ścian naczyń mózgowych w rozwoju obrzęku mózgu”.

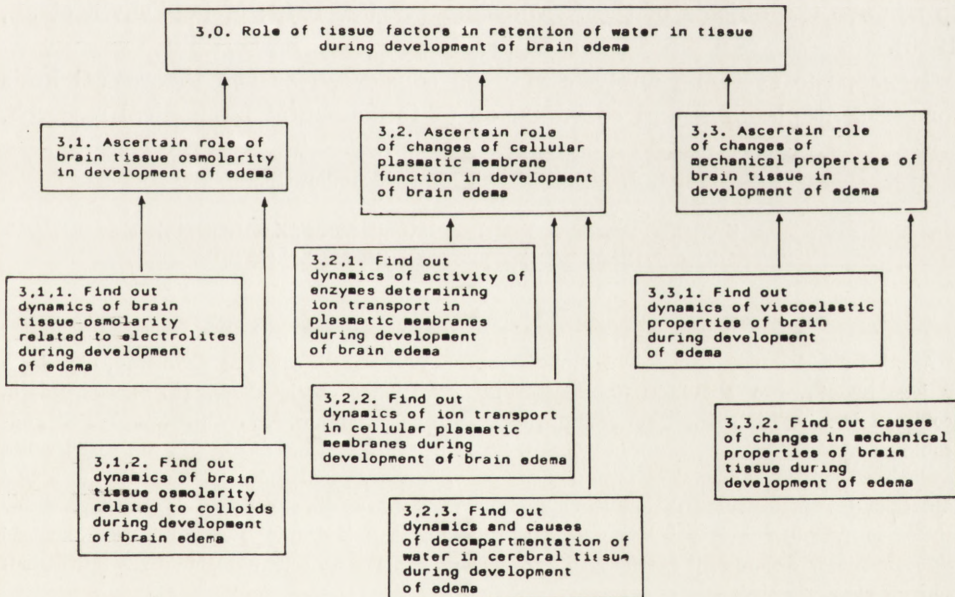


Fig. 4. Graph of objectives for subproblem 3,0 „Role of the tissue factors in the retention of water in brain during the development of edema”.

Ryc. 4. Wykres zadań w podproblemie 3,0 „Rola czynników tkankowych związanych z zatrzymaniem wody w mózgu w rozwoju obrzęku mózgu”.

The systemic analysis of a scientific problem with the composing of graphs of the problems and the objectives for each subproblem may be used for several purposes: Firstly, the systemic analysis of a scientific problem may be used for an efficient planning of research into any fundamental problems. The graphs help to find out what has actually been done before and, thus, which objectives are to be chosen for further research, and how they are related to the other objectives of the problem. Secondly, the systemic analysis of a scientific problem may be helpful in determining where the interests of individual laboratories and researchers converge. Thus, it may help to find where a joint work may be conducted and where research is to be coordinated. In this way it may help to eliminate replicating studies by researchers in different laboratories, to prevent futile expenditure of financial and human resources in research.

On the other hand, the systemic analysis of scientific problems may be efficiently applied for the organization of symposia aimed at determining the extent of solution of individual fundamental problems. This may considerably help in determining what questions constituting the research objectives have been already answered and hence no longer need any further investigation: this in its turn will help to obtain future research goals. On this basis, the fourth Tbilisi Symposium on the problem of mechanisms of regulation of cerebral blood flow was organized.* This helped considerably to achieve the objects of the Symposium (Waltz, 1978; Mchedlishvili et al., 1980).

Hence, the systemic analysis may be considered as the theoretical basis for efficient planning and coordination of fundamental biomedical research.

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ANALIZA SYSTEMOWA PROBLEMU „PATOFIZJOLOGICZNE
MECHANIZMY ROZWOJU OBRZĘKU MÓZGU”

Streszczenie

Analiza problemu składała się z dwóch etapów. Wykreślono schemat problemu, określając jego podstawowe składowe (podproblemy) wymagające wyjaśnienia dla rozstrzygnięcia problemu jako całości. Następne stadium stanowiło określenie schematu poszczególnych podproblemów, wyznaczające cele szczegółowe, których realizacja jest niezbędna dla rozwiązania każdego z podproblemów. Tego typu systemowa analiza problemów naukowych może być użyteczna dla efektywnego planowania badań, w szczególności dla określenia zbieżnych punktów zainteresowań poszczególnych laboratoriów i grup badaczy. Z drugiej strony może ona znaleźć zastosowanie w organizacji konferencji naukowych, mające na celu określenie zasięgu zamierzonych rozstrzygnięć.

* The problem of the physiological mechanisms of the development of brain edema is planned to be the topic of the next (the 5th) Tbilisi Symposium to be held in 1982—1983.

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СИСТЕМНЫЙ АНАЛИЗ ПРОБЛЕМЫ „ПАТОФИЗИОЛОГИЧЕСКИЕ
МЕХАНИЗМЫ РАЗВИТИЯ ОТЕКА ГОЛОВНОГО МОЗГА”

Резюме

Анализ проблемы состоял из двух этапов. Авторы вычертили схемы проблемы, определяющую ей основные составные части (подпроблемы), требующие выяснения для решения проблемы, как целого. Следующей стадией было определение схемы отдельных подпроблем, устанавливающее детальные цели, осуществление которых необходимо для разрешения каждой подпроблемы. Этого рода системный анализ научных проблем может быть полезен для эффективного планирования исследований, особенно для определения сходящихся заинтересованностей отдельных лабораторий и групп исследователей. С другой стороны он может найти применение в организации научных конференций, целью которых является определение предела намеренных решений.

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