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On the Problems of Computer-Assisted Treament Choice

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An algorithm of treatment and transport measures after head injuries is described. The verification of the algorithm was tested at 100 patients and in consultation service for non-specialised surgical departments in the Region of East Bohemia. Analysis of results is presented.

INTRODUCTION

The diagnostic process is often considered the acme of the physicians skill and greatest attention is given to it in computer simulation. In practice, however, the diagnosis is only the first stage of medical care to which the next stage is linked up, the treatment choice. Decision making does not finish with the making of diagnosis, on the contrary, it rather begins. There even are situations in which the diagnosis is not definitely made, notwithstanding the treatment must be launched. In such cases the treatment plan is given by the symptoms. That is comprehensible, because the diagnosis is an artificial, historically conditioned entity, whereas the symptoms are objective manifestations of a disease and they are not dependent upon the medical knowledge and approach.

These problems are not sufficiently worked out at present. The use of computers for treatment planning was theoreticaly designed by Ledley [1, 2] and was based on the value and game theory. We turned away Ledley's design as it did not conform to the practical solving. In many medical branches the treatment is planned, in individual cases, on the basis of pathophysiological symptoms and not only on the diagnosis. It is especially striking in surgical emergency diseases. We strongly believe that in those cases it is of advantage to base the model of treatment choice and planning on the logical relations among symptoms which agrees with the physician's thought. Even the development of the disease in time must be necessarily comprehended as a symptom. Our approach to the treatment choice we have simulated for acute states after head injuries.

The states after head injuries represent special problems, especially from the point of view of the transport and the treatment. The same treatment measure, e.g. a trepanation, can be designed in different diagnoses. The model answers the question if surgical treatment is necessary, or if conservative treatment is sufficient, if the wounded is to be transported to specialized ward, it warns of the possible complications and recommends supplementary examinations.

THE SOLVING OF THE MODEL

On the basis of our former works [3, 4] twenty symptoms were chosen that appear as most advantageous for the assessment of head injuries (Table I – The symptoms are selected from the list of symptoms for the diagnosis of head injuries and therefore are not numbered successively.)

Table I.

List of Symptoms

S1	– Brain mass in the wound
S2	– Conscious at the time of injury
S3	– Unconscious at the time of injury
S7	– Permanently in the state of consciousness (or unconsciousness)
S8	– Relapsed into unconsciousness after minutes or hours
S9	– Relapsed into unconsciousness after several days
S10	– Relapsed into unconsciousness after 1–2 months
S11	– Lost consciousness or condition worse within 2 hours – 2 days
S12	– Condition worse between 3–14 days
S13	– Condition worse about 30th day
S18	– Unilateral mydriasis
S19	– Epileptic convulsions
S20	– Disturbance of vital functions (respiration, pulse, blood pressure)
S23	– Fever
S24	– Difficult respiration due to discharge of mucus
S28	– Rhinorrhea
S30	– Impression of the skull
S34	– Condition improving
S36	– Accelerated respiration
S37	– Labored respiration

They embrace data about dynamics of the state of consciousness, about the clinical picture and about the results of the X-rays examination. The recommended measures are listed in Table II.

Table II.

List of Measures

1 — Trepanation indicated — transport the patient
2 — Urgent condition, immediate trepanation indicated
3 — Supervision in a specialized department necessary
4 — Conservative treatment sufficient
5 — Contrast examination in a specialized department necessary
6 — Transport patient to a specialized department — contrast examination or exploratory burrhole necessary
7 — Patient may be hospitalized in a non-specialized ward EEG examination desirable
8 — Give antibiotics
9 — Elevation of bone fractions indicated
10 — Think of pulmonary embolism
11 — Suspected bronchopneumonia
12 — Tracheotomy may become indispensable
13 — Tracheotomy indicated
14 — Open head injury
15 — Decision only after subsequent examination

The flow chart of the whole algorithm of the treatment measures is shown in Fig. 1. The whole logic structure is divided into four groups. The onset of each group is indicated with the figures 1, 2, 3, 4. In the groups 1, 2 and 3 the question of conservative or surgical treatment is solved. In the group 4 the designs on the complementary treatment are done and a warning as to possible complications. In the group 1 the symptom S7 has a special position because it means the duration of a given state of consciousness. Therefore: logical product S7.S2 means that the patient is permanently in the state of consciousness and S7.S3 on the other hand means that the patient is permanently in the state of unconsciousness.

In case that no measure is selected on the base of the given symptoms, the answer 15 from Table II is printed.

CONCLUSIONS

The physician's mission culminates only after the treatment choice and planning. No doubt, the diagnosis is a very important guidance within the framework of medical care, however, the treatment is given by the dynamic of pathological state.

Practical verification of the model was done on 100 patients who were treated for head injuries at the Department of Neurosurgery, Charles University Medical Faculty at Hradec Králové. In all cases the measure designed by the computer was in agreement with the medical intervention actually performed.

After this verification the model was tested as a consultation service for 27 non-specialized surgical departments in the Region of East Bohemia. During a three-week

period the consultation time was from 15 to 17 hours on weekdays and continuous on weekends. During this period the computer was asked in 23 cases. The results of the diagnostic part of the model were described in other papers [5, 6]. The results of the treatment measures part were as follows. In four cases the transport to neurosurgical ward was recommended. Trepanation was indicated in five cases and elevation of bone fractions in two. All measures were really done and were found correct.

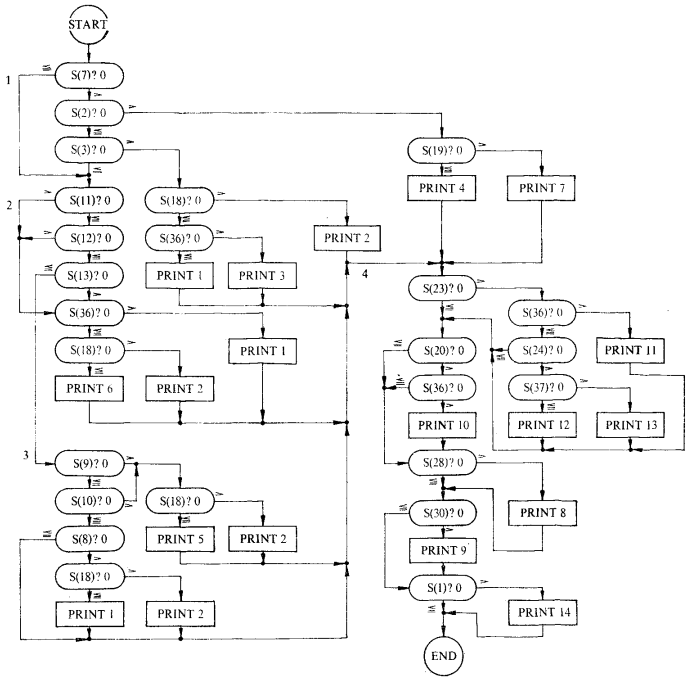

Fig. 1. Flow chart of the algorithm of the treatment measures. For explanation see text.

In two cases the recommended measure was wrong. In the first, respiratory difficulties were considered a pulmonary embolism, in the second was wrongly indicated a contrast examination, but in this case the mistake was due to faulty report of symptoms and not to shortcomings in the programme. In all the other cases the measure 15 from Table II was recommended.

The experiment with computer-assisted diagnosis connected with treatment measures proposal for a big region was the first of its kind and not only in our country. It appears that the computer is capable of solving complicated medical situations and of effective aid to medical care process.

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VÝTAH

K problému použití počítače při volbě léčebných opatření

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V článku je popsán algoritmus léčebných opatření při úrazech hlavy. Na základě dvaceti symptomů je dčláno čtrnáct léčebných a transportních opatření. Algoritmus byl ověřen u 100 nemocných, léčených pro úraz hlavy a ve všech případech se navržené léčebné opatření shodovalo se zákrokem skutečně provedeným.

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