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METHODOLOGICAL DESCRIPTION OF BRAIN DEATH DEFINITION

The traditional definition of death of the whole organism as the state of irreversible termination of blood circulation turned out to be useless in situations, increasingly more common in intensive therapy units, when circulation and other bodily functions are sustained artificially. Thus this definition has been replaced with a new one, namely the definition of the death of the human organism as a whole. The basis for this definition is a mechanical understanding of the organism – the whole organism may be dead even though some parts are still alive; similarly we consider a mechanism to be out of order even though some parts still function properly. We believe that a mechanism as a whole is broken down when its most important part cannot function. The main part of the human body is the brain, and an irreversible damage of brain stem indicates death. The new definition is described as the definition of brain death. It can be explained in the following terms: “The death of the human organism is constituted by an irreversible termination of the functioning of the brain stem”. According to this definition the fact that the brain has irreversibly lost its ability to direct body functions allows physicians to turn off the systems sustaining the functioning of particular parts of the body (artificial respiration, artificial circulation etc.) It is believed that the human organism as a whole is a system consisting of many inter-connected subsystems. Thus if the brain stem loses its ability to conduct integrative functions, particular sub-systems (live or artificially sustained) do not any longer constitute a live human organism as a whole.

As it can be seen, the definition of death has a certain diagnostic purpose, that is, it should facilitate in practice the recognition of the defined status, i.e. the death of the whole human body. This type of aim is attributed to the so called real definitions, that is, such which offer an unambiguous

description of the object defined; a real definition of an object is a statement which states about that object something which may truly be stated about one and only one object¹. It does not seem, however, that the definition of brain death of a human could be considered a real definition. Even though it is a real definition, the problem lies in the fact that it could fulfil its diagnostic purpose only under such circumstances when the termination of the functioning of brain were a well-defined condition, that is not requiring empirical procedures leading to its recognition. The medical problem is, however, determining through proper examining procedures, whether, in a given case, the brain stem cannot function – if the condition of irreversible damage is found empirically, it is believed that the human body is dead. However, this decision does not recognise the objective, realistic condition, but it is arbitrary made agreement that the recognition of certain state is the recognition of the death of the human being. Thus methodologically it is arbitrary, i.e. made to meet the aim which is to be achieved; in the medical sense it is essentially justified, i.e. made on the basis of the knowledge used.

From the methodological point of view, we deal here with two types of definitions, distinct and different in kind – the definition of death of the brain stem and the definition of death of the human organism. It seems, however, that the definition of death of the brain stem complies with the scheme of so called operational definitions. An operational definition describes the defined notion by giving the operations leading to the creation of the notion. The scheme of the operational definition is the following sentential formula: $\forall x[Px \rightarrow (Qx \equiv Rx)]$, where Q represents the defined notion, Px stands for the description of the conducted operation, while Rx stands for the description of the behaviour of the object which undergoes this operation². Let us thus try to define death of the brain stem using the scheme provided. We will do it according to the instructions of the Polish Ministry of Health and Social Care from 29 October 1996 concerning the criteria of brain death.

According to the ministerial instructions, the recognition of death of the brain stem has to be based upon the recognition of irreversible loss of its function. This condition is to be recognised by a two-stage-qualifying proce-

¹ See K. Ajdukiewicz, *Pragmatic Logic*, translated by O. Wojtasiewicz, Warsaw 1974, p. 81.

² The given formula should be read as follows: “for each x , if Px then Qx only and only if Rx ”. The symbol corresponding to the phrase “for each x ”, i.e. so called universal quantifier. The sentential function occurring behind the quantifier is said to be within the range of this quantifier.

dure. At the first stage only the suspicion of brain stem death is undertaken. In order to make this suspicion likely, a series of findings and exclusions in the patient needs to be done. It has to be stated that the patient is in a state of a coma; is under artificial breathing; the cause of the coma has been recognised; the structural damage to the brain has been proved; and it has been found out that the damage is irreversible due to the exhaustion of the possibilities of the further therapy and the passage of time³. At the same time this potential group should exclude patients who are poisoned, under the influence of some drugs, in the state of hypothermia caused by external factors, with metabolic or endocrinological disturbances, with convulsions and decerebrate spasms, as well as mature new-born babies younger than seven days. From the logical point of view these considerations should be treated as a definition of a set of values of an individual variable x , that is from the range of the name “patient in whom the termination of the function of brain stem, that is brain death, is suspected”.

The second stage involves carrying out of certain tests, which confirm the absence of stem reflexes and the recognition of apnea. A whole sequence of such tests should be conducted, as only their appearance together allows us to state brain death. It is evident that from the logical point of view we deal here with the presence of not only the one sentential function $Px \rightarrow (Qx \equiv Rx)$ within the range of a universal quantifier, but also the conjunction of many sentential functions of this kind. As a consequence, the operational definition of brain stem death qualifies within the following scheme:

$$\forall x\{[P_1x \rightarrow (Qx \equiv R_1x)] \wedge [P_2x \rightarrow (Qx \equiv R_2x)] \wedge \dots \\ \dots \wedge [P_nx \rightarrow (Qx \equiv R_nx)]\}.$$

This scheme can also be similarly written down in the following way:

$$\forall x[P_1x \rightarrow (Qx \equiv R_1x)] \wedge \forall x[P_2x \rightarrow (Qx \equiv R_2x)] \wedge \dots \\ \dots \wedge \forall x[P_nx \rightarrow (Qx \equiv R_nx)].$$

According to the instructions of the Ministry of Health and Social Care on the criteria of brain death, six tests should be conducted to confirm the absence of stem reflexes and one confirming the recognition of apnea; thus the definition of brain stem death can be given as a conjunction of seven sentences:

³ The recognition of the cause of coma is of utmost importance as there are known cases of deep coma caused by factors other than permanent damage to brain stem, e.g. due to overdose of drugs, inborn enzymatic defects, temporary damage to brain due to anoxia.

$$\forall x[P_1x \rightarrow (Qx \equiv R_1x)] \wedge \forall x[P_2x \rightarrow (Qx \equiv R_2x)] \wedge \dots \\ \dots \wedge \forall x[P_6x \rightarrow (Qx \equiv R_6x)] \wedge \forall x[P_7x \rightarrow (Qx \equiv R_7x)].$$

In the first six sentences within the range of the quantifier there are sentential functions describing the lack of stem reflexes (determined by symbols R_1, R_2, \dots, R_6) while the sentential function R_7 from sentence seven is a description of apnea. Symbol Q stands for the expression “brain stem is dead”. Since the description of the required tests (description of operations indicated in the scheme by symbols P_1, P_2, \dots, P_7) is unimportant for this discussion, in the sentential functions below only the names of the tests are given⁴.

Operational definition of brain stem death given in Polish instructions can thus be described as a conjunction of the following seven sentences:

1. “for each x , if x has been submitted to the test of reaction to light, brain stem is dead only and only if x ’s pupils do not react to light”;
2. “for each x , if x has been submitted to the test of cornea reflex, brain stem is dead only and only if x lacks cornea reflex”;
3. “for each x , if x has been submitted to caloric test, brain stem is dead if and only if x lacks eyeball movements”;
4. “for each x , if x is submitted to tests of reaction against pain, brain stem of x is dead if and only if x lacks any reaction against pain within the area of skull nerves”;
5. “for each x , if x is submitted to tests of vomit and cough reflex, brain stem of x is dead if and only if x lacks vomit and cough reflexes”;
6. “for each x , if x is submitted to a test of eye-brain reflex, brain stem of x is dead if and only if x lacks eye-brain reflex”;
7. “for each x , if x is submitted to a test of apnea, brain stem of x is dead if and only if x lacks breath reaction”;

Of course the definition of brain stem death characterised above is not a definition of death of human organism⁵. It is only a defined notion, which

⁴ This can be illustrated by the example of the description of caloric test: in order to check whether the patient has full patency of external auricular canals we should direct a stream of 20 ml of cold water (temp. 3–10 degrees C) upon the tympanum and observe the nystagm of eyeballs.

⁵ New York Institute of Society, Ethics, and Life Sciences created a special team – Task Force on Death and Dying – in order to prepare a report on methodological and deontological property of criteria of brain death. The report found that all these criteria should be sufficiently clear and simple so that they could be used by physicians as a routine, while being at the same time clear for lawyers; additionally, it was underlined that traditional criteria should not be eliminated (such as those which determine the termination of spontaneous breathing and circulation, in those cases in which artificial support of these functions was not in use. See *Refinements in Criteria for the Determination of Death: An Appraisal*, A Report by the Task Force on Death and Dying of the Institute

can now serve as a defining notion in the definition of the death of the organism: “The death of the human organism as a whole is a state in which death of brain stem occurred”. For stylistic reasons the phrase “state in which death of brain stem occurred” shall be replaced with a phrase “condition of irreversible termination of function of brain stem”. This definition will then take the form of “Death of human organism is a state of irreversible termination of functioning of brain stem”. Since it is not a question of the whole organism, but organism as a whole, an exact expression will be: “Death of human organism as a whole is a state of irreversible termination of functioning of brain stem”.

The above definition is undoubtedly a real one as it gives explicit (unambiguous) characteristics of the object defined. Since the defining notion (i.e. “irreversible termination of functioning of brain stem”) was already previously defined operationally, the given definition fulfils also a diagnostic purpose, that is, it allows a recognition of the defined object, namely the condition of death of organism. Furthermore, the definition formed in this way can be given one more task which has been indicated by philosophers since Aristotle’s time – the requirement that real definitions give not only unambiguous, but also essential descriptions of objects they define⁶; in this case it would be essential features of the condition of death of organism.

The requirement that the definition should give essential features must be related to a given field, that is, a real definition should provide those features which are significant, that is, particularly important in a given field. This creates a difficult problem of deciding which features of a defined object may and should be found as relevant from the point of view of a given field; more precisely – due to research purposes of a given field. Of course, aims in theoretical sciences (both humanities and natural sciences) are different from applied sciences. The main aim of theoretical sciences is to discover natural regularities, their explanation and predicting, on this basis, events so far unobserved. Applied sciences aim to indicate means necessary to reach certain goals. Thus it should be discussed whether the definition: “Death of a human organism as a whole is a state of irreversible termination

of Society, Ethics, and the Life Sciences, “Journal of the American Medical Association” 221, 1, 1972, 48-53 In the editorial comment of JAMA to the report it was found to be justified to stress: “Criteria, any criteria, do not *define* death. Rather, they can allow us to say only that death has occurred. It is detection rather than definition. Thus, they are merely tools and their proper use depends on proper judgement”; *Harvard Criteria: An Appraisal*, Editorial Comment, “Journal of the American Medical Association” 221, 1, 1972, p. 65.

⁶ See K. Ajdukiewicz, *op. cit.*, p. 83.

of functioning of brain stem” belongs to theoretical science, namely biology, or practical science, namely medicine.

The problem of death belongs, of course, to the discipline of biology, as biology is a science concerning live organisms – death remains within the realm of biology only as it is the end of the living organism. Is biology, however, able to answer the question of what life is, and, as a consequence, what death is, if the question involves indicating relevant features of these notions? There is no doubt that the question posed in this way goes not only beyond the realm of biology, but natural sciences in general, as it is also a psychological problem, as well as – even more importantly – a philosophical one. Thus the definition of the death of the organism as a whole is not a theoretical definition, but a practical one – it belongs not to theoretical biology, but to medicine as a practical science.

It should be stressed that the definition of death of human organism is not a definition of death of a human being. If we assume that a human being is a live organism, which has real or potential consciousness, as a consequence we will agree that human organism ceases to be a human being at the moment of irreversible termination of functions of consciousness of the brain. Thus the definition of death of a human being could have the following form: “The death of a human being is a state of irreversible termination of functioning of higher parts of the brain”. In order for this definition to fulfil practical aims – particularly to describe the moment when the resuscitation of a person whose higher brain functions are irreversibly damaged (whose cortex area is irreversibly destroyed), although brain stem is still alive – an operational definition of death of higher parts of brain should be given, in analogy to the definition of death of brain stem. It seems that the present level of medical science does not make it possible to formulate such a definition.