THE INVESTIGATION OF DIATOMS DEMONSTRATING DEATH CAUSED BY DROWNING

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The diagnosis «death caused by drowning» is still a difficult and actual problem confronted by forensic medicine. This is due to the circumstance that as yet, there are no pathognomonic signs of drowning discovered, particularly as regards decomposed cadavera.

To find an answer to the basic question — death by drowning or by various causes — along with the data of the external and internal examination and histological investigations, also a number of laboratory methods are used, all based on the study of elements penetrating the blood circulation with the liquid received. The difference in the freezing point of blood from the left and right halves of the heart — cryoscopic method of Carrara, electroconductivity of blood, hemolysis of blood etc. have been investigated. However, the methods listed above failed to attain a universal acceptance because of the need of specialized laboratories, laboratory equipment and the like. A number of authors (1, 2, 5, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21, 23) recommend the search for diatoms in the internal organs as an accurate and comparatively simple for execution method. Early in the century, Revenstorf and Stocks (8) suggested to look for mineral particles and plankton elements in the blood of the left and right halves of the heart, as well as in the periphery of the lungs. The latter method was subjected to manifold verifications, but the data have invariably been discordant. Some of the authors state that in drowning, hard particles inevitably penetrate the circulation with the liquid (1, 2, 6, 7, 13, 15, 16, 21) and accordingly the establishing of such particles is to be considered an absolute proof for death occurring by drowning. Others (3, 4, 18, 19) question the value of this method of investigation, bearing in mind the very wide spreading of diatoms in the nature and their finding in the organs removed from cadavera in which the death was not caused by drowning.

We set out to verify the diagnostical value of this method under local conditions — drowning exclusively in the Black Sea — proceeding from the fact that similar studies in this country have not been conducted hitherto, and also from the fact that most of the authors referred to have studied cadavera of persons drowned in fresh water swimming pools (2, 3, 4, 6, 9).

Material and Method

Forty one cadavera of drowned individuals were investigated, comprising three in advanced decomposition stage, 13 cadavera of persons dying from other causes (injuries, sudden death, hanging), as well as 50 rats, of which 30 drowned in sea water, rich in diatoms, 10 killed and 10 killed and thereafter kept in sea water. In each of the human cadavera we investigated the lung, myocardium, kidneys and liver, whereas in the rats — only the lungs. The organs were removed by strictly abiding to the requirements considered as mandatory for avoiding additional penetration of diatoms — special armamentarium for dissection and absolutely sterile equipment. After experiments with various methods (10, 14, 22, 24), we chose the method described by Prokop (24), consisting in destruction of the organic material with concentrated sulphuric acid and subsequent addition of nitrous acid, after heating. After splitting of the form elements, the liquid is diluted with distilled water and subjected to centrifugation, with beforehand severalfold washing of the centrifuge with distilled water. The washed up sediment resulting is mounted on object glasses and observed under microscope. Of each single object (organ), an average of 3—5 preparations are studied under the microscope — in dark field. Our material is distributed according to age and sex in the following fashion: Table 1.

Table 1

Age	Up to 10 y.	10—20 y.	20—30 y.	30—40 y.	40—60 y.	Above 60	Total
Total number	3	11	15	6	10	9	54
Men	2	8	14	5	8	6	43
Women	1	3	1	1	2	3	11

It is evident from the Table that males prevail, as well as individuals in mature age as compared to children and young people. In Table 2, the number of organs investigated from the control cadavera and cadavera of drowned persons is presented. A total of 173 organs were investigated, and in single cases — only the lung.

Table 2

N° of organs investigated in one cadaver	Controls		Death caused by drowning		Total N° adavera	Total N° organs
	Investigated cadavera	Investigated organs	Investigated cadavera	Investigated organs		
1	3	3	2	2	5	5
2	4	8	5	10	9	18
3	2	6	8	24	10	30
4	4	16	26	104	30	120

The results concerning the incidence of establishing diatoms in the internal organs of drowned persons and in those of the control series are illustrated in Table 3. Our results are in compliance with the data reported by a number of authors (2, 9, 13, 15, 16, 17, 21). Most frequently, diatoms are

Table 3

Organs investigated	Control investigations		Cadavera of drowned persons		%
	Number	Diatoms discovered	Number of objects	Positive results	
Lung	13	1	41	36	87,8
Myocardium	10	—	39	30	76,9
Kidney	6	—	34	22	67,4
Liver	4	—	26	14	53,8
Total	33	1	140	93	

discovered in the lungs, next ranking the myocardium and much more rarely in the kidneys and liver. In one of the control cases, we established diatoms in the lung, which might be due to additional soiling. Diatoms were not discovered in the intrenal organs without their parallel establishing in the lungs.

In all the 30 rats drowned we discovered diatoms, but in those swimming freely the amount of diatoms was much higher, than in the other group of 10 rats, drowned in a static position. In the 10 rats killed by mechanical route, diatoms in the lungs were not discovered, whilst in the cadavera of rats killed and thereafter kept in sea water, rich in diatoms, for 24 hours, diatoms were established only in 2 of the 10 cases studied.

On the ground of the investigations performed, the folowing inferences are reached:

The quantity of diatoms established in the lung in 36 cases, and in the myocardium — in 30 cases, in the kidneys — in 22 cases and liver — 14 cases, as well as the finding of an isolated diatom in the lung of a cadavera from the control group, and demonstrated after the method described by Prokop (24), gives us sufficient reason to recommend this method as a routine one whenever difficulties arise in the course of forensic medical investigation of cadavera of drowned persons, and particularly after the occurrence of cadaveric decomposition. Whenever diatoms are not established in the lungs, it is unnecessary to search them in the other internal organs. The failure to find diatoms should by no means rule out the death by drowning owing to the fact that their quantity may be reduced, or else, the failure of discovering them may be due to the still unrefined method of work — processing of the material, microscopic studies etc. The experiments demonstrate first, that postmortem penetration of diatoms is effected in comparatively low percentage and, second, that the amount of diatoms depends to a great extent on the way drowning occurred. In our material, the cases with absence of diatoms, in the lungs inclusive, concern mainly adult individuals, in whom we could hardly state with certainty if death in the water was not provoked by some other cause.

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ИССЛЕДОВАНИЕ ДИАТОМЕЙ, КАК ДОКАЗАТЕЛЬСТВО СМЕРТИ, НАСТУПИВШЕЙ ВСЛЕДСТВИЕ УТОПЛЕНИЯ

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РЕЗЮМЕ

Авторы занимались отысканием диатомей в 41 трупе утопленников, 13 трупах при смерти, наступившей по другим причинам и у 50 подопытных животных.

Рекомендуется используемый авторами метод обнаружения диатомей, состоящий в обработке материала концентрированной серной и азотной кислотами.

Получены следующие положительные результаты у трупов утопленников: лекие 87,8%, миокард — 76,9%, почка — 67,4%, печень — 53, 8%. В контрольной группе лишь в одном трупе обнаружено наличие диатомей в легком. У подопытных животных диатомеи были обнаружены у всех 30 утопленных крыс, а у умертвленных механическим способом диатомеи обнаружены не были.

Наличие диатомей является безошибочным доказательством смерти от утопления, особенно в разложившихся трупах или в трупах, не имеющих типичную секционную картину этого вида смерти.