

Acta Medica Okayama

Volume 13, Issue 3

1959

Article 9

OCTOBER 1959

Ex-perimental study and practice on the detection of vegetative planktons in the bone marrow of the drowned dead body

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Abstract

Experiment on the animals proved that in the case of the death by drowning planktons always immigrate into the bone marrow and some kinds of them can be detected in the bone marrow even after a long period of time, suggesting that the detection of these planktons in the bone marrow of the dead person will give the important clue for the determination of the cause of death by drowning. Actually applying this method in a decayed corpse, we could successfully show the cause of death is due to drowning in which the cause of death was long argued in the court.

Acta Med. Okayama 13, 259—268 (1959)

**EXPERIMENTAL STUDY AND PRACTICE ON THE
DETECTION OF VEGETATIVE PLANKTONS IN THE
BONE MARROW OF THE DROWNED DEAD BODY**

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Received for publication, April 17, 1959

The death by drowning may be determined in several ways, but in a case in which corpse has disintegrated so badly as to be in a form of skeleton the detection of the vegetative planktons in the bone marrow will have a great significance as stated by HOFFMAN¹⁾ and other authors²⁻¹⁸⁾. However, there is very possibility that the planktons will disintegrate in the course of time and become undetectable. It is unfortunate that there is hardly any report on the duration how long vegetative planktons can be reserved in the dead body, especially in the skeleton after a laps of long period of time. Under the consideration in such a doubtful case we attempted to reveal on the dead animal how long the planktons immigrated into bone marrow can be reserved, and it has been revealed that the detection of planktons is useful to get the evidence of the death by drowning even after more than a year. In this paper we describe the experiments on the rabbits dead by drowning and a case in which the cause of death was discussed in the court for a long period and the detection of the planktons in the bone marrow gave the final determination for the cause of the death.

MATERIALS AND METHODS

33 healthy adult rabbits, male and female, weighting about 2.5 kg were used. Those animals were divided into 11 groups, three animals in each. The animals belonging to the same group were put together in a cage made of metal mesh and sunk in the creek named Edagawa, a small branch of Asahigawa River, where the water was found to be rich in planktons. Then the animals were drowned to death by keeping the cages in water for about 15 minutes. After drawing them out of water, the four legs of each animal were cut off and femur and humerus were stripped of fresh. The bones from the first group were observed without any treatment. The bones from all other groups were put in the vinyl bags and

buried under the ground, about one meter depth. Each group of three animals was dug out respectively 1, 2, 3, 4, 5, 6, 8, 10, 12, and 15 months afterwards and the bones were examined for the vegetative planktons.

As the method to detect planktons, the whole bones were put into the flask containing about 20 cc of fuming nitric acid and boiled till the bones were dissolved and then hydrogen peroxide was added until the solution became clear. This clear solution was centrifuged for 20 minutes at 3000 r. p. m.

RESULTS OF EXPERIMENT

The planktons detected in the water of the creek where the rabbits had been drowned were consisted of different kinds as shown in the table 1; two kinds of *Cymbella*, *Navicula*, *Nitzschia* each and one of *Melosira*, *Cyclotella*, *Rhopalodia*, *Diploneis* and *Tabellaria* each. Among them *Melosira islandica*, *Navicula placentula*, *Navicula radiosa*, *Cymbella parva* and *Cyclotella comta* were found to be the largest in number.

Table 1 The diatoms detected in the same water of the river where the rabbits were drowned.

kinds	Date											
	1957 5/X	5/XI	5/XII	1958 5/I	5/II	5/III	5/IV	5/VI	5/VIII	5/X	1959 5/I	
Months after death	0	1	2	3	4	5	6	8	10	12	15	
<i>Cymbella naviculi formis</i>	+	+	+	+	+	+	+	+	-	-	-	
<i>Cymbella parva</i>	+	+	+	+	+	+	+	+	+	+	+	
<i>Navicula placentula</i>	+	+	+	+	+	+	+	+	-	-	-	
<i>Navicula radiosa</i>	+	+	+	+	+	+	+	+	+	+	+	
<i>Nitzschia filiformis</i>	+	+	+	+	+	+	+	-	-	-	-	
<i>Nitzschia vermicularis</i>	+	-	-	-	-	-	-	-	-	-	-	
<i>Melosira islandica</i>	+	+	+	+	+	+	+	+	+	+	+	
<i>Cyclotella comta</i>	+	+	+	+	+	+	+	+	+	+	+	
<i>Rhopalodia gibba</i>	+	+	+	+	+	+	+	+	+	+	-	
<i>Diploneis elliptica</i>	+	-	-	-	-	-	-	-	-	-	-	
<i>Tabellaria fenestrata</i>	+	-	-	-	-	-	-	-	-	-	-	

Planktons detected in the bone of the rabbits observed on the day of drowning proved to be the same as those found in the water from the creek presenting the all kinds of planktons just mentioned. But after one month, 3 among 11 kinds, i. e. *Nitzschia vermicularis*, *Diploneis elliptica* and *Tabellaria fenestrata* could not be found. After eight months *Nitzschia filiformis* disappeared in addition. One year and 3 months

afterwards further *Rhopalodia gibba* disappeared, and *Cymbella parva*, *Navicula radiosa*, *Melosira islandica* and *Cyclotella comta* were the only ones remaining.

COMMENT

As can be understood from the results mentioned above, some kinds of planktons immigrated from water into bone marrow at the time of drowning disappear in a comparatively short time afterwards, i. e. three kinds of planktons including *Nitzschia vermicularis*, *Diploneis elliptica* and *Tabellaria fenestrata* could not be found already one month after the drowning. However, other kinds of planktons were found to be reserved well till 6 months after the death. After 6 months the disappearance of some kind of planktons becomes very rapid as indicated in table 1. This may give an impression that the disappearance of the planktons may be delayed during winter as this experiment was started in October. Actually the data presented by one of our colaborators, SHIRAGAMI¹⁹⁾, show the accelerated disappearance of planktons in the similar experiments conducted in summer comparing to that in winter, i. e. *Diploneis elliptica*, *Nitzschia vermicularis*, *Tabellaria fenestrata*, *Nitzschia filiformis* and *Cymbella naviculiformis* disappeared within two months in summer, while in the experiment conducted during winter *Cymbella naviculiformis* were proved to be retained after two months. But the four kinds of plankton, *Cymbella parva*, *Navicula radiosa*, *Melosira islandica* and *Cyclotella comta* were found to be very resistant and proved to be reserved well until 15 months after the death without showing any morphologic change, suggesting that these ones will be useful to determine whether or not the cause of death of the corpse is due to drowning even after the laps of a long period of time.

CONCLUSION

From the results the author reached the following conclusions. Among the planktons found in the creek four kinds, namely *Cymbella parva*, *Navicula radiosa*, *Melosira islandica* and *Cyclotella comta* were found to be very resistant and will be kept well in the corpse as long as 15 months after the death by drowning. It may be deduced from this observation that these planktons will be useful in determining the cause of death by drowning.

MEDICO-LEGAL EXAMINATION OF ONE CASE

The accident happened in July 1956 when the school children in the first, second and third graders were taking the swimming lesson in the Shinjyo River in the northern part of Okayama prefecture. A girl X, 8 years old, in the second grade died during the lessons.

The cause of death was determined by a doctor as due to the heart attack by physical examination immediately after the death. But in the autopsy performed on her body on the following day by a police doctor her death was attributed to drowning and the teacher in charge was suspected of negligent homicide.

The corpse was buried without cremation after autopsy. And after several weeks the case was brought up to the court. But the attorney in deference of the teacher claimed that the teacher was not responsible for the death on the basis of the opinion of the first doctor.

Thereby the confusion arose on the judgement, and then it was required to confirm definitely the actual cause of death by the reinvestigation of the corpse.

INVESTIGATION

In October of 1958, two years and four months after the death of the girl, one of the authors, Mikami was ordered by the judge to have the remains of the child exhumed and carry out tests to determine the cause of death.

Then in the middle of December, the authors with one technician exhumed the corpse. The corpse was laid in the coffin of cryptomeria at the depth of 95 cm. under the ground. Her height was 123 cm. The skull was partially exposed and mass of hair, about 15 cm. in length, was still on the head but the coronary seam was loosened about 0.1 cm. in width. The loosening of the other seams and the fracture of bones could not be observed. The face was almost completely decayed as to expose the bone. Some parts of the cheeks had white mold covering. The soft tissues of the opened mouth were disintergrated and a few teeth had fallen out. In the neck the soft tissues also decomposed exposing the neck bones which were loosened. In the thoracic area the ribs were exposed and the abdominal region was collapsed showing the dark brown color with some dried dark skin like leathers. The thoracic cavity contained the soft decayed masses of dark reddish brown and the thoracic vertebrae were in places separated each others.

The organs in the abdominal cavity were collapsed and in the stomach

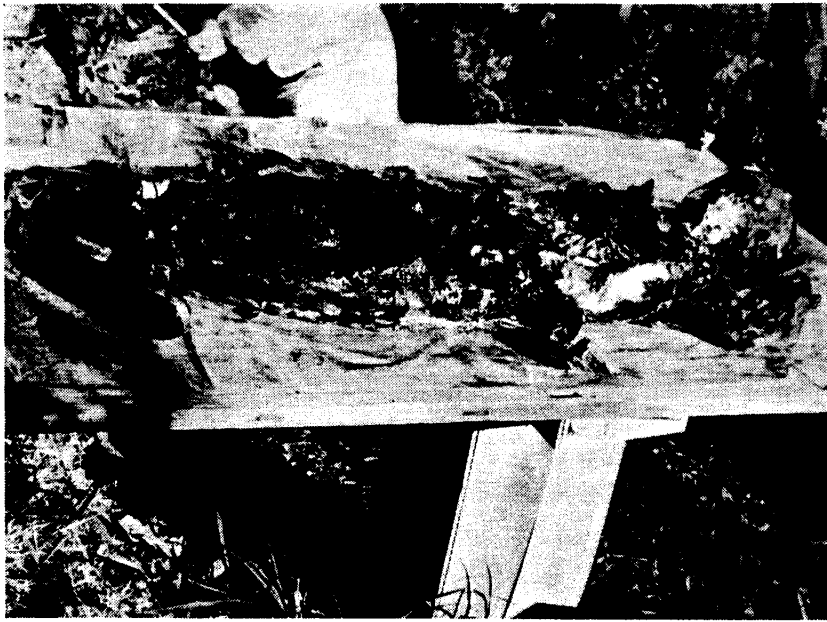


Fig. 1 Gross appearance of the exhumed body of the girl.

some of reddish brown sticky substance was found. The small and large intestines still kept their shapes but were decayed and collapsed in some parts. The back was covered with yellowish brown gelatinous skin exposing the ribs in some parts. Both left and right legs were covered with the soft decayed tissues of light yellowish brown but no fracture in bones. The pudental and anal parts were completely decayed.

Table 2 Names, lengths and weights of the bones brought back.

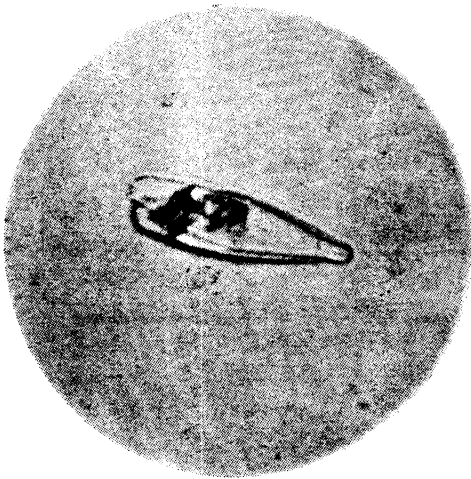
Bones		lengths	weights
Humerus	left	18.0cm.	27.9 g.
	right	17.9cm.	28.0 g.
Radius	left	14.2cm.	10.9 g.
	right	14.3cm.	11.2 g.
Ulna	left	12.6cm.	8.0 g.
	right	12.6cm.	7.8 g.
Femur	left	25.5cm.	88.5 g.
	right	26.0cm.	92.2 g.
Tibia	left	19.9cm.	51.9 g.
	right	20.1cm.	51.2 g.
Fibula	left	20.2cm.	13.1 g.
	right	20.2cm.	13.4 g.

From the findings mentioned above it was deduced that the exhumed body is in a far advanced stage of decay and the cause of death can't be judged only from the gross autopsy findings. Therefore, the long bones of the corpse were separated from the soft tissues and taking back to the laboratory for the purpose of the detection of planktons. The bones taken back and their lengths and weights are shown in the table 2. Among these bones femur, tibia and humerus only were chosen for the examination. Each of the bones mentioned above was washed in distilled water changing the water about ten times and dried. Then, bones were cut longitudinally using the saw washed clearly with distilled water. From the bone marrow of each bone the sticky mass light yellowish brown was accumulated separately. The obtained materials were put in the flaskets respectively and added 10cc of fuming nitric acid and then an equal

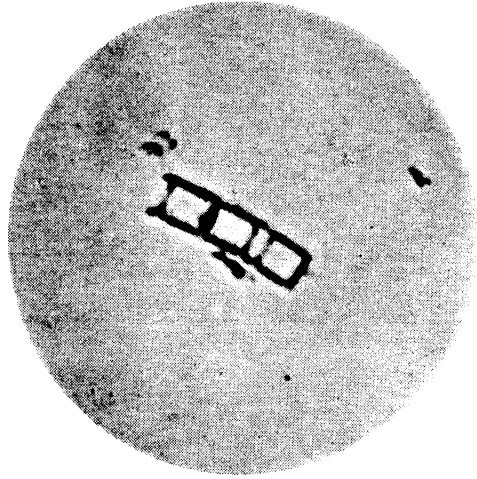


Fig. 2 The humerus of the exhumed corpse having the disintegrated marrow tissue.

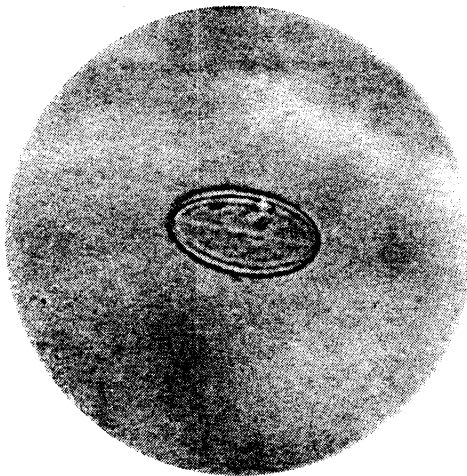
Fig. 3 Vegetative planktons detected from the bone marrows of the girl exhumed two years and 4 months after the death.



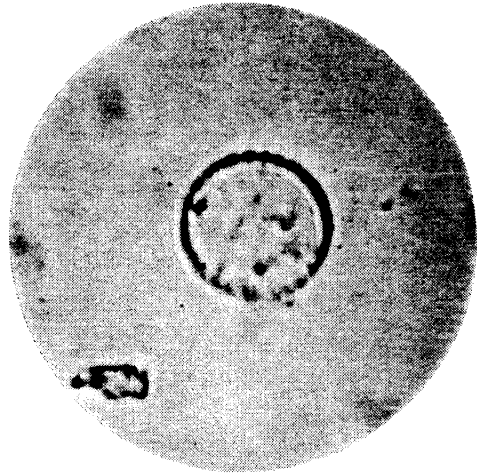
Navicula radiosa



Melosira islandica



Diploneis elliptica



Cyclotella comta

Fig. 4 Vegetative planktons detected from the water of the Shinjyo River where the girl was drowned.



volume of concentrated sulfuric acid and boiled until the materials were completely resolved. Then, hydrogen peroxide was added until the solutions became clear. After cooling the solutions were centrifuged and the sedimented materials were observed under the microscope.

Observations revealed that the sediments include a small number of planktons. *Cyclotella comta* and *Melosira islandica* from the marrow of humerus, *Cyclotella comta*, *Navicula radiosa*, *Melosira islandica* and *Diploneis elliptica* from the marrow of femur, *Cyclotella comta*, *Navicula radiosa*, *Melosira islandica* from the marrow of tibia.

Examining the water of the river, where the girl died, by the same method, the following seven kinds of planktons were detected: *Cyclotella comta*, *Navicula radiosa*, *Melosira islandica*, *Tabellaria fenestrata*, *Nitzschia filiformis*, *Diploneis elliptica*, and *Cymbella parva*. That is, the four kinds of planktons out of seven kinds found in the river water were detected in the bone marrow of the corpse.

From these results of the medico-legal examination it has been confirmed clearly that the cause of death of this child is due to drowning in the river.

SUMMARY

Experiment on the animals proved that in the case of the death by drowning planktons always immigrate into the bone marrow and some kinds of them can be detected in the bone marrow even after a long period of time, suggesting that the detection of these planktons in the bone marrow of the dead person will give the important clue for the determination of the cause of death by drowning.

Actually applying this method in a decayed corpse, we could successfully show the cause of death is due to drowning in which the cause of death was long argued in the court.

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