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TEMPORAL SPECTRAL CHANGE OF THE DEGREE OF DEPOLARIZATION OF LASER RADIATION SCATTERED BY THE HEPATIC TISSUE TO DIAGNOSE THE PRESCRIPTION OF DEATH COMING

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Abstract. The authors have carried out a comparative study a temporal change of distributions of the degree of depolarization of laser radiation scattered by the hepatic tissues for the purpose of searching new parameters of diagnosing the prescription of death coming.

Key words: death, asphyxia, blood loss, laser, polarimetry.

Introduction. The basic tasks of practical forensic medical experts are establishing the cause of death and the prescription of its coming that is very complicated due to the absence of circumstances and objective data which would be able to point out a possible time of its coming.

Object and tasks. This research is aimed at detecting temporal spectral changes of depolarizing laser irradiation by means of sections of the human hepatic tissue to diagnose the time of death coming.

Material and methods. Sections of the hepatic tissue of people who died as a result of mechanical asphyxia ("A") – 42 defuncts and massive blood loss ("B") – 40 defuncts. The sections under study were placed in a laser unit where a collimated beam radiation was carried out (Ø=10^4 μm) of He-Ne laser (λ=0.6328 μm) [9]. Polarizing images, were formed in the plane of a light-sensitive platform (800×600) of the CCD camera whence they were transmitted to a personal computer to implement furthers mathematical processing [3].

Discussion of the results of the research. A series of laser images [1, 2, 4-8] of hepatic tissue sections of types A and B is presented in fig. 1.

As a result of an analysis of laser images obtained one can establish:

all the types of investigated objects possess an optically anisotropic component, illustrating distinct from zero the distributions of intensity of laser radiation in the right column of fig. 1.

a higher level of the intensity of laser radiation is characteristic of polarization images of the biological tissues of type "A" in comparison with the similar polarizingly visualized structures of the biological tissue of type "B".

The results of investigating the temporal evolution for the depolarization degree for imaging the hepatic tissue of type "B" for the time of registration 1 and 8 hours after death coming are presented in a series in fig. 2 and 3.

An analysis of experimentally obtained findings of the structure of a depolarized component and temporal evolution of laser radiation scattered by the hepatic tissues has revealed:

- structural hetergeneity of two-dimensional distributions Δ(x, y) that are formed by a combination of predominantly small-scale sites values of the degree of depolarization, arranged randomly in the shear plane of the hepatic tissue.
- an increase of the level of the depolarization of scattered radiation and a transformation of the sizes of sites of identical values Δ(x, y) in a direction of enlarging geometrical dimensions (fig. 3) with a time increase after death coming.
- a slower temporal change of three-dimensional distributions of the degree of depolarization compared with dependencies Δ(x, y).

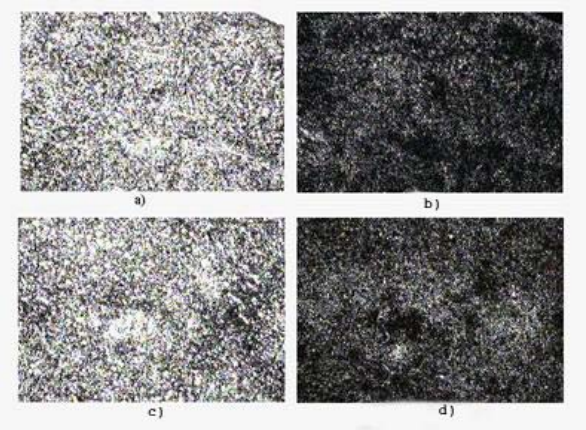

Fig. 1. Polarizing images of the hepatic tissue: a), b) type B; c), d) type A

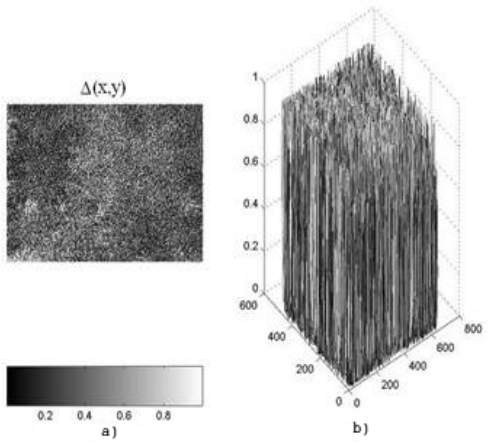

Fig. 2. Distributions of the degree of the image depolarization for λ = 0. 6328 μm of the hepatic tissue of type "B" for the time registration of 1 hour following death coming: a) coordinate; b) three-dimensional

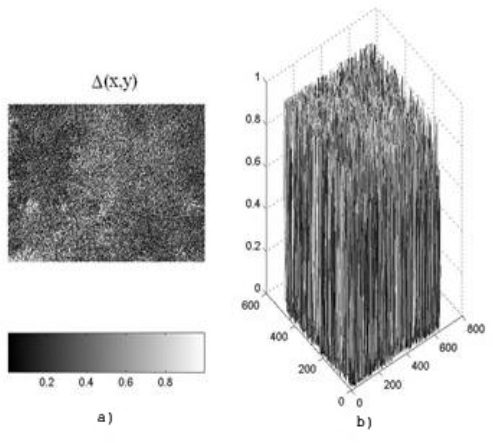

Fig. 3. Distributions of the degree of the image depolarization for λ = 0. 6328 μm of the hepatic tissue of type "B" for the time registration of 8 hours following death coming: a) coordinate; b) three-dimensional

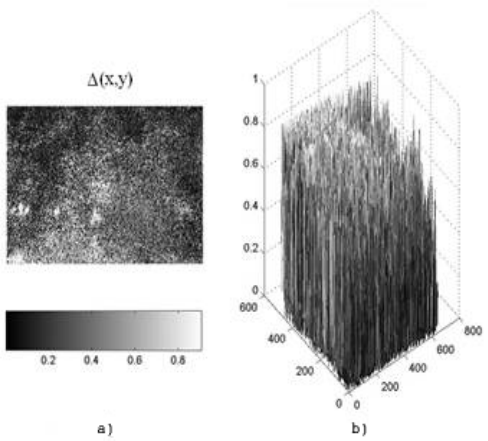

Fig. 4. Distributions of the degree of the image depolarization of the hepatic tissue of type "A" for the time registration of 1hour after death coming: a) coordinate; b) three-dimensional

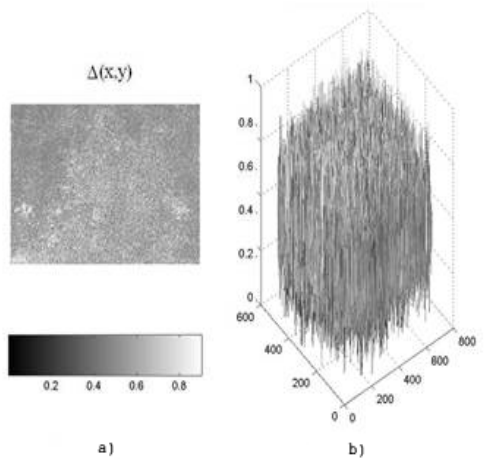

Fig. 5. Distributions of the degree of the image depolarization of the liver tissue of type "A" for the time registration of 8 hours following death coming: a) coordinate; b) three-dimensional

Table 1

Time dependences of a dispersion of the distribution of the degree of the polarization of laser radiation by the liver tissue

The cause of death	Time interval after death coming *T*. hrs							
	1	4	12	24	32	40	48	56
Blood loss	0,09± 0,007	0,12± 0,015	0,15± 0,019	0,23± 0,023	0,32± 0,035	0,38± 0,041	0,36± 0,042	0,37± 0,045
Asphyxia	0,11± 0,011	0,15± 0,017	0,21± 0,024	0,24± 0,021	0,31± 0,032	0,36± 0,035	0,39± 0,034	0,38± 0,043

The revealed specific characteristics of a transformation of polarized layer radiation that passed through the blood saturated laser of the hepatic tissue may be associated with the following features of its morphologic structure.

The hepatic tissue, its parenchyma is made up of small-scale structures, measuring 10-40 μm. After the passage of the laser beam the coordinate distribution within the limits of the shear plane is formed in the shape of small-scale sites.

Similar tendencies of a change of the two-dimensional and three-dimensional structure of the depolarization degree were detected for laser radiation scattered by the hepatic tissue of type A.

In the series of fig. 4 and 5 the results of investigating the temporal evolution of the degree of depolarization for an image of postmortem changes of the hepatic site of type A for the registration of time after 1 and 8 hours are adduced.

The findings (fig. 4 and 5) obtained by the authors illustrate a field of scattered laser radiation with a high total level of its depolarization at the expense of intensive light scattering, making it possible to study more thoroughly more large-scale (fragments "a") structures

of Δ(x, y) for a minor dynamic time change of three-dimensional distributions (fragments "b").

Apart from this, a more intensive formation of larger sites at the expense of a change of the depolarization degree is observed. This circumstance, to our way of thinking, is associated with intensive processes of corpse changes of the liver tissue.

Table 1 presents the results of a study of a time change of the most wide spread statistical parameter – a dispersion of the values of the depolarization degree.

It is seen on the basis of the results obtained, that a variance of values of the degree of the depolarization of laser radiation for different wave-lengths increases monotonously with a prolongation of time after death coming and reaches a certain level of saturation which defines a restriction of the range of determining the prescription of death coming.

Conclusions

Thus, one can certify that the time range of a change makes up 42 hours for laser radiation scattered by the tissue of type A, for the liver tissue of type B – 54 hours. The defined time ranges enable to diagnose the time of death coming via a statistical analysis of the depolarization of laser radiation by the liver tissue.

Prospects of further studies. The use of a three-dimensional parameter of the depolarization of laser radiation scattered by sections of the biological tissues of the human body may be used for a search of new criteria for an expansion of possibilities of diagnosing the time of death coming.

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ВРЕМЕННОЕ СПЕКТРАЛЬНОЕ ИЗМЕНЕНИЕ СТЕПЕНИ ДЕПОЛЯРИЗАЦИИ ЛАЗЕРНОГО ИЗЛУЧЕНИЯ, РАССЕЯННОГО ТКАНЬЮ ПЕЧЕНИ ДЛЯ ДИАГНОСТИКИ ВРЕМЕНИ НАСТУПЛЕНИЯ СМЕРТИ

В.Т.Бачинский, О.В.Павлюкович, О.Я.Ванчуляк, И.Г.Савка

Резюме Проведено сравнительное исследование временного изменения распределения степени деполяризации лазерного излучения, рассеянного тканями печени с целью поиска новых параметров диагностики времени наступления смерти.

Ключевые слова: смерть, асфиксия, кровопотеря, лазер, поляриметрия.

ЧАСОВА СПЕКТРАЛЬНА ЗМІНА СТУПЕНЯ ДЕПОЛЯРИЗАЦІЇ ЛАЗЕРНОГО ВИПРОМІНЮВАННЯ, РОЗСІЯНОГО ТКАНИНОЮ ПЕЧІНКИ ДЛЯ ДІАГНОСТИКИ ЧАСУ НАСТАННЯ СМЕРТІ

В.Т.Бачинський, О.В.Павлюкович, О.Я.Ванчуляк, І.Г.Савка

Резюме Проведено порівняльне дослідження часової зміни розподілів ступеня деполяризації лазерного випромінювання, розсіяного тканинами печінки з метою пошуку нових параметрів діагностики часу настання смерті.

Ключові слова: смерть, асфіксія, крововтрата, лазер, поляриметрія.

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