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ESTIMATION OF TIME SINCE DEATH THROUGH ELECTRIC AND CHEMICAL EXCITABILITY OF MUSCLES

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A b s t r a c t: Electric and chemical excitability of muscles present a supravital reaction which is of major importance in achieving a more precise estimating of the time since death in the early post-mortem period.

The purpose of this paper is to examine the electric and chemical excitability of the muscles in cases with a known time of death, in order to determine their importance in the estimation of time since death.

Electric excitability and chemical stimulation have been analysed in 50 cases with a known time of death, taken for autopsy at the Institute of Forensic Medicine and Criminology in Skopje in the course of the year 2005.

Testing of electric excitability of the muscles was done with a device for electric stimulation, providing a direct current of 50 mA intensity and 50 Hz frequency.

Testing of chemical excitability of the eye pupils was done by injecting miotic Carbahol into the front eye chamber of the right eye and mydriatic Adrenalin HCl into the front eye chamber of the left eye.

By analysis and processing of the obtained results, it was determined that the electric excitability of the muscles is of a major importance in determining the time since death within a post-mortem period of up to 10 hours and chemical excitability for a post-mortem period of up to 12 hours.

Key words: time of death, electric excitability, chemical excitability, reaction.

Introduction

The estimation of time since death is an issue of particular interest in all cases of violent, unknown and suspicious deaths. Precision of the answer is substantial to the reconstruction and clarification of the circumstances, especially in cases of an-witnessed murder done by an unknown killer, car-hit casualties with a lethal result where the driver escaped from the scene of the event, and many other situations. The estimate of the time since death, after the first 24–48 hours (the so-called early post-mortem period) is determined by routinely applying conventional methods of corpse examination and detecting the development of post-mortem changes [2, 3, 4, 6, 14].

Due to the great variations in time of occurrence and duration of such corpse changes, influenced by many endogenous and exogenous factors, it allows only an approximate determination of the time of death in a few hours' interval after death [11, 12, 13, 15].

Electric and chemical excitability of muscles present supravital reactions of major importance in achieving a more precise estimate of the time since death. Electric stimulation is done to the muscles around the eyes (m.orbicularis oculi) and the muscles around the mouth (m.orbicularis oris) because they are easily accessible and reaction is clearly visible. Chemical reaction is done to the flat muscles of the iris in the eye since they react over a longer post-mortem period [1, 5, 7, 8].

Objective

The purpose of this paper is to test the electric and chemical excitability of muscles in cases with a known time of death, i.e. to determine the post-mortem period in which there is a reaction to chemical stimulus, its intensity and duration and to use obtained results for determining their importance in estimating the time since death.

Materials and work method

Electric excitability and chemical stimulation have been analyzed with 50 cases with known time of death, taken for autopsy at the Institute of Forensic Medicine and Criminology in Skopje in the course of the year 2005, with a post-mortem period of 2 to 24 hours.

Testing electric excitability of the muscles was done with a device for electric stimulation, providing a direct current of 50 mA intensity and 50 Hz frequency.

Fig. 1 – Testing of m.orbicularis oculi

Fig. 2 – Testing of m.orbicularis oris

Testing of m.orbicularis oculi (Fig. 1) was done by the insertion of electrodes into the upper eye liad at intervals of 1.5–2 cm, at depth 0.5–0.1 cm; obtained results were classified in four levels depending on the intensity of response [9, 10].

I degree – contraction of facial musculature on the same side

II degree – contraction of lower and upper eyelids

III degree –contraction of the upper eyelid

IV degree – contraction of medial part of the upper eyelid

Testing of m.orbicularis oris (Fig. 2) was done by the insertion of electrodes at 1 cm distance from the mouth angles, at 0.5–1 cm depth; obtained results were classified in three levels depending on the intensity of response [9, 10].

I degree – contraction of whole musculature around the mouth

II degree – contraction of m.orbicularis oris

III degree – excitation in the form of muscle trembling

Testing the chemical excitability of the pupils of the eyes was done by injecting miotic Carbahol (Fig. 3) into the front eye chamber of the right eye and mydriatic Adrenalin HCl (Fig. 4) into the front eye chamber of the left eye (about 0.5 ml of the solution; the concentracion used is not important) [5].

Time of reaction occurrence was noted and duration of the reaction.

Fig 3 – Chemical excitability by miotic

Fig 4 – Chemical excitability by mydriatic

Results and discussion

Table 1

Electrical excitability – musculus orbicularis oculi

Hours PM	n	Gradation				
		I ++++	II +++	III ++	IV +	No reaction
2–3	**5**	**3**	**2**	**–**	**–**	**–**
4–5	**5**	**–**	**2**	**3**	**–**	**–**
6–7	**5**	**–**	**–**	**1**	**4**	**–**
8–9	**5**	**–**	**–**	**–**	**4**	**1**
10–11	**5**	**–**	**–**	**–**	**–**	**5**
12–13	**5**	**–**	**–**	**–**	**–**	**5**
14–15	**5**	**–**	**–**	**–**	**1**	**4**
16–17	**5**	**–**	**–**	**–**	**–**	**5**
18–19	**5**	**–**	**–**	**–**	**–**	**5**
20 >	**5**	**–**	**–**	**–**	**–**	**5**

From Table 1 it can be observed that upon electric excitation of the m.orbicularis oculi, a positive reaction of I degree was obtained in 3 cases with a post-mortem time of 2 and 3 hours, i.e. a post-mortem time of less than 4 hours. A II degree reaction was obtained in 4 cases, post-mortem time 2–5 hours; a III degree reaction was obtained in 4 cases, post-mortem time 4–7 hours; a IV degree reaction in 8 cases, post-mortem time 6–9 hours. In cases with a post-mortem time of 10 or more hours a positive reaction to electric excitement was missing, except in one case of 14 hours post-mortem time.

Table 2

Electrical excitability – musculus orbicularis oris

Hours PM	n	Gradation			
		I +++	II ++	III +	No reaction
2–3	**5**	**2**	**3**	**–**	**–**
4–5	**5**	**–**	**1**	**4**	**–**
6–7	**5**	**–**	**–**	**4**	**1**
8–9	**5**	**–**	**–**	**1**	**4**
10–11	**5**	**–**	**–**	**–**	**5**
12–13	**5**	**–**	**–**	**–**	**5**
14–15	**5**	**–**	**–**	**–**	**5**
16–17	**5**	**–**	**–**	**–**	**5**
18–19	**5**	**–**	**–**	**–**	**5**
20 >	**5**	**–**	**–**	**–**	**5**

From Table 2 it can be observed that a positive reaction of I degree was obtained in 2 cases with a post-mortem time of 2 and 3 hours; a II degree reaction was obtained in 4 cases, post-mortem time 2–5 hours; a III degree reaction was obtained in 8 cases, post-mortem time 4–7 hours and also in 1 case with a post-mortem time of 8 hours. In cases with a post-mortem time of 10 or more hours a positive reaction was missing.

Table 3

Chemical excitability by myotic-carbahol

Hours PM	n	Onset of reaction	Duration	No reaction
2–3	**5**	**< 10 s**	**2–4 h**	**–**
4–5	**5**	**< 3 min**	**1,5–3 h**	**–**
6–7	**5**	**< 5 min**	**1,5–3 h**	**–**
8–9	**5**	**< 10 min**	**1–2 h**	**–**
10–11	**5**	**< 10 min**	**1–2 h**	**–**
12–13	**5**	**< 10 min**	**1–1,5 h**	**2**
14–15	**5**	**< 10 min**	**1–1,5 h**	**1**
16–17	**5**	**< 10 min**	**1–1,5 h**	**3**
18–19	**5**	**< 10 min**	**1–1,5 h**	**3**
20 >	**5**	**10 min >**	**1 h**	**4**

By analysing the results of Table 3, it can be observed that for a post-mortem period of 2 and 3 hours a positive reaction is obtained – myosis for a time of 5–10 seconds, lasting 2–4 hours. The longer the post-mortem period is, the longer is the time of occurrence of the reaction, whereas the duration of reaction decreases. Thus, for a post-mortem period of 14 and more hours, a reaction appears in 5–10 minutes, and lasts 1–1.5 hours. Upon chemical excitation with Carbahol a certain positive reaction is obtained for a post-mortem period of up to 12 hours; for a post-mortem period of 12 or more hours the reaction was uncertain.

Table 4

Chemical excitability by mydriatic – Adrenalin HCl

Hours PM	n	Onset of reaction	Duration	No reaction
2–3	**5**	**< 10 s**	**2–4 h**	**–**
4–5	**5**	**< 3 min**	**1,5–3 h**	**–**
6–7	**5**	**< 5 min**	**1,5–3 h**	**–**
8–9	**5**	**< 10 min**	**1–2 h**	**–**
10–11	**5**	**< 10 min**	**1–2 h**	**–**
12–13	**5**	**< 10 min**	**1 h**	**2**
14–15	**5**	**< 10 min**	**1–1,5 h**	**1**
16–17	**5**	**< 10 min**	**1–1,5 h**	**3**
18–19	**5**	**< 10 min**	**1 h**	**3**
20 >	**5**	**10 min >**	**1 h**	**4**

Table 4 shows that a positive reaction (midriasis) in cases with a 2 or 3 hour post-mortem period was obtained in a maximum of 10 seconds and reaction duration was 2–4 hours. With an increase of the post-mortem time, the time needed for the reaction increases also, whereas its duration decreases. In cases with a post-mortem period of 12 or more hours, the reaction occurrence time is extended up to 10 minutes whereas the duration of the reaction decreases to 1–1.5 hours. Upon chemical excitation with Adrenalin HCl a certain positive reaction is obtained for a post-mortem period of up to 12 hours; for a post-mortem period of 12 or more hours the reaction was uncertain.

Conclusion

Electric excitation of m.orbicularis oculi and m.orbicularis oris give a reaction of highest intensity (I degree) for a post mortem time of 2–3 hours whereas intensity of reaction decreases with the increase of the post-mortem period.

Electric excitation of m.orbicularis oculi results in a definite positive for a post-mortem time of up to 8 hours whereas for m. orbicularis such a reaction is obtained for a post-mortem period of up to 6 hours. After 10 hours post mortem there is no reaction to electric stimulus.

A positive reaction upon chemical excitation with Carbahol and Adrenalin HCl is obtained with certainty for a post-mortem time of up to 12 hours.

It can be concluded that the electric excitability of muscles plays a major role in estimating the time of a post-mortem period of up to 10 hours, and chemical excitability with a post-mortem period of up to 12 hours.

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Резиме

ОДРЕДУВАЊЕ НА ВРЕМЕТО НА СМРТТА ПРЕКУ ЕЛЕКТРИЧНА И ХЕМИСКА ЕКСЦИТАБИЛНОСТ НА МУСКУЛИ

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Апстракт: Електричната и хемиската ексцитабилност на мускулите претставуваат суправитална реакција која е од големо значење за попрецизно одредување на времето на смртта во раниот постмортален период.

Целта на овој труд е да се испита електричната и хемиската ексцитабилност на мускулите кај случаи со познато време на смрт за да се утврди нивното значење при одредувањето на времето на смртта.

Електричната и хемиската ексцитабилност се анализирани на 50 случаи со познато време на смрт, обдуцирани во Институтот за судска медицина и криминалистика во Скопје во периодот на 2005 година.

Испитувањето на електичната ексцитабилност на мускулите е извршена со апарат за електрична стимулација на мускули кој обезбедува еднонасочна струја со јачина од 50mA и фреквенција од 50Hz.

Испитувањето на хемиската дразба на пупилата на окото се изведува со вбризгување на миотик Carbahol во предната очна комора на десното око и мидриатик Adrenalin HCl во предната очна комора на левото око.

Со анализа и обработка на добиените резултати се одреди дека електричната ексцитабилност на мускулите има големо значење при одредување на времето на смртта кај постмортален период до 10 часа, а хемиската ексцитабилност кај постмортален период до 12 часа.

Клучни зборови: време на смртта, електрична ексцитабилност, хемиска дразба, реакција.

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