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Postmortem prothrombin time

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Introduction : *In forensic autopsy, hemorrhage in vital organs as a cause of death may be resulted from previous coagulopathy. Toxicity of warfarin after rodenticide ingestion also presents with coagulopathy. However, there has not been any postmortem investigation to confirm antemortem coagulopathy or coagulopathy from warfarin.*

In living a person, prothrombin time is a simple and low cost test to evaluate coagulopathy. However, there has not been any study on postmortem prothrombin time.

Purposes : *To study postmortem prothrombin time and to evaluate whether it can be applied in forensic practice.*

Setting : *Chulalongkorn Forensic Center, Faculty of Medicine, Chulalongkorn University.*

Subjects : *Thirty-two corpses sent to Chulalongkorn Forensic Center for autopsy from October 2006 to December 2006 were recruited under selection criteria.*

Design : *Descriptive study.*

Methods : *Blood collections from 32 corpses were sent to laboratory for prothrombin time test.*

Results : *Postmortem prothrombin time in all corpses was prolonged.*

Conclusions : *The results of this study show that prothrombin time after death is prolonged. Therefore, it is useless to request postmortem prothrombin time test in the diagnosis of antemortem coagulopathy or coagulopathy from warfarin.*

Keywords : *Postmortem prothrombin time, Coagulopathy, Warfarin.*

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- บทนำ** : ในการผ่าชันสูตรศพทางนิติเวช สาเหตุการตายที่เกิดจากการมีเลือดออกในอวัยวะสำคัญ อาจเป็นผลจากความผิดปกติในการแข็งตัวของเลือด ยาเบี๋อหนูในกลุ่ม warfarin ก็มีผลให้มีเลือดออกผิดปกติได้ อย่างไรก็ตาม ยังไม่มีวิธีการตรวจทางห้องปฏิบัติการภายหลังจากการเสียชีวิต เพื่อวินิจฉัยความผิดปกติ ของการแข็งตัวของเลือด ทั้งจากความผิดปกติในการแข็งตัวของเลือดก่อนที่เสียชีวิตหรือผลจาก warfarin
- ในคนที่มีชีวิต Prothrombin time เป็นวิธีการตรวจทางห้องปฏิบัติการที่ง่ายและประหยัดในการประเมินความผิดปกติของการแข็งตัวของเลือด อย่างไรก็ตาม ยังไม่เคยมีการศึกษาถึงการเปลี่ยนแปลงของ Prothrombin time ภายหลังจากการเสียชีวิต
- วัตถุประสงค์** : เพื่อศึกษา Prothrombin time ภายหลังจากการเสียชีวิตและพิจารณาว่าสามารถนำมาใช้ในงานด้านนิติเวชได้หรือไม่
- สถานที่ทำการศึกษา** : ศูนย์อำนวยการชันสูตรพลิกศพ คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
- ตัวอย่างที่ทำการศึกษา** : ศพผู้เสียชีวิตจำนวน 32 รายที่ถูกส่งมาผ่าชันสูตรศพที่ศูนย์อำนวยการชันสูตรพลิกศพ คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ที่เข้าได้กับเกณฑ์การเลือกศพผู้เสียชีวิตเพื่อทำการวิจัยในระหว่างเดือนตุลาคม พ.ศ.2549 ถึงเดือนธันวาคม พ.ศ.2549
- รูปแบบการวิจัย** : การวิจัยเชิงพรรณนา
- วิธีการศึกษา** : ศพผู้เสียชีวิตที่เข้าได้กับเกณฑ์การเลือกศพผู้เสียชีวิต เพื่อทำการวิจัยจำนวน 32 ราย จะถูกเจาะเลือดเพื่อส่งตรวจทางห้องปฏิบัติการในการหา Prothrombin time
- ผลการศึกษา** : ผลการศึกษาพบว่า Prothrombin time ภายหลังจากที่เสียชีวิตในศพผู้เสียชีวิตทุกราย จะมีค่านานขึ้น
- สรุป** : จากการวิจัยแสดงให้เห็นว่า เมื่อเสียชีวิต ค่า Prothrombin time จะนานขึ้น ดังนั้น จึงไม่มีประโยชน์ที่จะทำการส่งตรวจ Prothrombin time ภายหลังจากที่เสียชีวิตแล้ว เพื่อใช้วินิจฉัยความผิดปกติในการแข็งตัวของเลือดก่อนที่จะเสียชีวิตหรือความผิดปกติในการแข็งตัวของเลือดจาก warfarin
- คำสำคัญ** : Postmortem prothrombin time, เลือดออกผิดปกติ, warfarin

In forensic autopsy, people who have antemortem coagulopathy may die from hemorrhage in vital organs such as brain and lungs. The severity of hemorrhage may be different from one to another. Ingestion of warfarin, a rodenticide, also causes abnormal bleeding.⁽¹⁾

In a living person, there are many tests to evaluate abnormal bleeding including⁽²⁾:

1. Tests on vascular and platelet phase: bleeding time, platelet enumeration, platelet volume measurements and platelet function assays.

2. Tests on coagulation phase: partial thromboplastin time, prothrombin time, thromboplastin generation test, assay of plasma fibrinogen and thrombin time and related techniques.

3. Others: test on factor XIII activity, fibrinolysis, etc.

Prothrombin time test is a simple and low cost, useful for the evaluation of the extrinsic pathway of coagulation as it is sensitive to reduced levels of factors II, V, VII and X. It takes seconds for clot formation after addition of calcium and thromboplastin. A common application is monitoring the effect of warfarin type anticoagulant.⁽³⁾

It is believed that prothrombin time should be prolonged after death. Some forensic doctors request postmortem prothrombin time test. But there is no conclusion regarding postmortem prothrombin time. Review from MEDLINE and many standard forensic textbooks, no study has been done on postmortem prothrombin time. This study is the first study on postmortem prothrombin time.

The purposes of this study are to know how prothrombin time changes after death and whether it can be used for forensic purposes.

Materials and Methods

This study included 32 corpses selected under inclusion criteria from autopsy cases at Chulalongkorn Forensic Center from October 2006 to December 2006.

The criteria for selection of the corpses in this study include⁽⁴⁻¹¹⁾:

1. Criteria at the crime scene:

- Unnatural death that needed autopsy
- Known time of death
- No history of hepatobiliary disease
- No history of warfarin use
- Age more than 6 months

2. Criteria at the autopsy room

- Received informed consent from the relatives
- No refrigeration
- No signs of coagulopathy
- No abnormalities of hepatobiliary systems
- No signs of sepsis or disseminated intravascular coagulopathy
- No signs of malnutrition

When a corpse was sent to Chulalongkorn Forensic Center, a blood specimen was immediately collected. The blood was drawn from the femoral vein under double-syringe collection technique to avoid contamination of the specimen with tissue thromboplastins.⁽³⁾

Then the blood specimen was pushed into a blue top(sodium citrate) tube as the container^(3,7) and was sent to the Hematology Laboratory of Clinical Pathology Department, Faculty of Medicine, Chulalongkorn University as soon as possible.

Statistic

Descriptive study.

Results

2006, 32 corpses fit in with the criteria for selection.

From 267 autopsied cases at Chulalongkorn (Table.1)

Forensic Center between October 2006 and December

Table 1. Prothrombin time from 32 corpses.

No.	Sex	Age (Years)	Postmortem interval* (hours)	Cause of Death	Manner of Death	Prothrombin time (seconds)
1	Male	40	5	Myocardial infarction	Natural	85.8
2	Male	45	4	Epidural hemorrhage	Accident	>100
3	Male	35	5	Brain contusion	Accident	>100
4	Male	39	3	Brain laceration	Accident	23.8
5	Male	22	3	Brain contusion	Homocide	>100
6	Male	47	5	Pulmonary edema	Natural	>100
7	Female	58	10	Myocardial infarction	Natural	70
8	Male	26	6	Lung laceration	Accident	>100
9	Male	52	7	Myocardial infarction	Natural	>100
10	Male	20	5	Brain asphyxia	Suicide	26
11	Female	14	5	Brain contusion	Accident	>100
12	Male	42	5	Myocardial infarction	Natural	58.8
13	Female	29	7	Cardiomyopathy	Natural	>100
14	Male	20	4	Brainstem laceration	Accident	17.2
15	Male	24	4	Brain laceration	Accident	24
16	Male	26	7	Drug overdose	Accident	26.8
17	Male	38	3	Myocardial infarction	Natural	>100
18	Male	24	5	Subarachnoid hemorrhage	Accident	>100
19	Male	43	7	Hypovolemic shock	Homocide	29.8
20	Male	17	5	Brain laceration	Accident	29.8
21	Male	66	3	Myocardial infarction	Natural	19.1
22	Male	34	4	Mitral stenosis	Natural	59.8
23	Female	70	2	Brain contusion	Accident	>100
24	Male	20	5	Hypovolemic shock	Homocide	>100
25	Male	55	5	Myocardial infarction	Natural	39.4
26	Male	31	3	Brain contusion	Accident	>100
27	Female	65	5	Coronary artery stenosis	Natural	>100
28	Male	55	6	Pulmonary edema	Natural	19.2
29	Female	29	5	Hypovolemic shock	Accident	>100
30	Male	37	5	Myocarditis	Natural	34.4
31	Male	45	3	Myocardial infarction	Natural	34.1
32	Male	17	7	Multiple organs injury	Accident	>100

*Postmortem interval = Time since death to blood collection

In normal population, the normal range of prothrombin time is from 10 to 13 seconds. At King Chulalongkorn Memorial Hospital, the normal prothrombin time is 12.8 seconds.

Causes of prolonged prothrombin time in living one might be from inhibition or deficiency of coagulation factors such as factor II, V, VII and X. Hepatobiliary diseases or warfarin type anticoagulants also prolong prothrombin time.

From 32 corpses in this study, 26 were male bodies and 6 were female bodies. The ages of the bodies were between 14 and 70 years. Postmortem intervals from the time of death to the time of blood collection were in the range of 2 to 10 hours. With the cause of death, 17 corpses died from trauma and 15 corpses died from diseases.

Prothrombin time in all corpses was prolonged with the minimum value of 17.2 seconds. Changes in prothrombin time in female bodies were more rapid than those in male bodies. Traumatic deaths also showed rapid changes of prothrombin time when compared to natural death.

Discussion and Conclusion

From a previous study on extrinsic factors in coagulation, plasma half-life of factors II, V, VII and X are 60-70, 12, 3-6 and 30-40 hours⁽¹²⁾, respectively. After death, these factors decreased with time so the prothrombin time should prolong.

This study confirms that postmortem prothrombin time prolong. The cause of prolonged prothrombin time after death may be explained by decrease of coagulation factors. But there should be other explanations why postmortem prothrombin time rapidly changes despite the least half-life of

coagulation factors is 3 hours.

Possible explanations may be biochemistry changes after death such as hypoxia or increased pH of the blood, which need further study.

In traumatic death, injuries may initiate a coagulation cascade, as the coagulation factors are used. After death, no more factors are produced in compensating the used factors. These may be explained that postmortem prothrombin time in traumatic death changes more rapidly than death from natural causes.

The result of this study reveals that postmortem prothrombin time is prolonged. Postmortem investigation of prothrombin time cannot be applied to diagnose of antemortem coagulopathy or toxicity of warfarin ingestion.

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