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Case Report

The Importance of Bloodstain Pattern Analysis in the Investigation of Road Traffic Accidents: A Case Report

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Abstract

Bloodstain pattern analysis has become a field of specialization in Forensic sciences and plays an important role in the reconstruction of events at a crime scene. Research, books, and articles have been published on the analysis and interpretation of bloodstain patterns

We present a case study of a road traffic accident in which bloodstain pattern analysis helped us to solve the discrepancy between reports produced by forensic examiners and by the forensic biology department.

The case was of a 22-year-old man who died immediately and a 31- year-old woman who survived a road traffic accident. They were both found outside their overturned car and it was impossible to ascertain from initial observations which of the victims was driving the car at the time of the accident. An external examination of the man revealed multiple injuries, and the cause of his death was severe brain injury. The woman survived with a fracture of the forearm, dislocated clavicle bone, and other minor injuries. After initial examination of the car and based on the pattern of injuries the deceased recieved, forensic examiner concluded that the man was the driving the car at the time of accident. On the other hand, the forensic DNA analysis of bloodstains obtained from the driver's seat matched that of the woman, suggesting that she was the driver. This apparent discrepancy directed the forensic examiner to carry out a bloodstain pattern analysis on the driver's seat. The bloodstain pattern analysis helped resolve the discrepancy and enabled the investigators to identify the driver correctly. This case report emphasizes the importance of bloodstain pattern analysis in the reconstruction of cases involving road traffic accidents.

Key words: Forensic science, Forensic Medicine, Bloodstain Pattern Analysis, Clothing, Road Traffic Accident

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أهمية تحليل أنماط بقع الدم في التحقيق في حوادث الطرق المرورية: تقرير حالة

المستخلص

يعد تحليل نمط بقع الدم تخصصاً من تخصصات علوم الأدلة الجنائية و يلعب دوراً هاماً في إعادة بناء الأحداث في مسرح الجريمة. وقد تم نشر العديد الأبحاث والكتب والمقالات حول تحليل وتفسير أنماط بقع الدم. نقدم هنا دراسة حالة حادث مروري على الطريق السريع، والتي ساهم تحليل نمط بقع الدم في حل التناقض بين التقارير الصادرة من قبل خبراء الأدلة الجنائية من جهة و قسم الأحياء الجنائية من جهة أخرى. حيث وقع حادث مروري لرجل يبلغ من العمر 22 عاماً، وقد توفى الرجل في ذلك الحادث على الفور، و كانت معه امرأة تبلغ من العمر 31 عاماً نجت من الحادث. وقد وجدَ كلاهما خارج السيارة التي انقلبت بهم، وهنا كان من المستحيل التأكد من خلال الملاحظات الأولية للضحايا من هو الذي كان يقود السيارة وقت وقوع الحادث.

كشف الفحص الخارجي للرجل وجود إصابات متعددة، وقد كان سبب وفاته إصابة شديدة في الدماغ، بينما نجت المرأة مع وجود

كسر في الساعد، وخلع في عظم الترقوة، بالإضافة لإصابات طفيفة أخرى. في بداية التحقيقات لم يلاحظ الطبيب الشرعي مسرح الحادث والسيارة، وخلص إلى أن الرجل هو الذي كان يقود السيارة استناداً إلى نمط الإصابات، في حين أن نتائج تحليل الحمض النووي الجنائي لبقع الدم التي تم رفعها من مقعد السائق تطابقت مع نظيرتها عند تحليل الحمض النووي الجنائي للمرأة، مما يرجح أنها من كان يقود السيارة. هذا التناقض الذي ظهر في التقارير جعل خبراء الأدلة الجنائية يقومون بإجراء تحليل لنمط بقع الدم على مقعد السائق. وقد ساعد هذا التحليل في حل ذلك التناقض وتمكين المحققين من تحديد السائق أثناء الحادث بشكل صحيح. ويؤكد هذا التقرير أهمية تحليل نمط بقع الدم في إعادة بناء مسرح الحادث في قضايا الحوادث المرورية على الطرق.

الكلمات المفتاحية: علم الأدلة الجنائية، الطب الشرعي، تحليل نمط بقع الدم، الملابس، حوادث المرور على الطرق.

Introduction

Bloodstain pattern analysis deals mainly with the physics and dynamics of blood as a fluid. It is used to evaluate blood deposited on different surfaces in crime scenes in order to reconstruct events, answer certain questions, or verify statements (1,7,9,14,15). The first study in bloodstain pattern analysis was published in 1895 by Edward Piotrowski [1].

This paper discusses a road traffic accident case in which a victim's statement was verified by analyzing the bloodstain pattern in the car.

Case presentation

This case involves a road traffic accident in which an overturned car was found on the highway by the police and ambulance service. A 22-year-old male who died on the spot, and a 31-year-old lady, the survivor, were both found outside the overturned car. The body of the man was transferred to the mortuary, and the woman was transferred to an emergency department in a hospital for treatment.

Examination of the man at the Forensic Medicine Department

On examination, the male weighed 86 kg with a height of 173 cm. He was wearing a white traditional thobe with multiple tears on the left sleeve and on the back.

The body had bruises on the skin on the left side of the forehead, a cut in the skin on the left eyebrow and in the middle of the forehead with a fracture of the underlying bones as well fractures of the cervical vertebrae, ribs, and both clavicle bones.

Bruises were found on the left shoulder, left lower quadrant of the abdomen, back side of the left arm, lower part of the back, the buttocks, external side of the left thigh, the back side of both knees and the middle of the frontal side of the right leg with a compound fracture of the tibia and abrasions in the skin at the back side of the right hand. Moreover, there was a tear of the skin at the medial malleolus bone of the left leg.

Laboratory investigation for alcohol, drugs, and medications was negative.

The cause of death was severe brain Injury.

Examination of the woman at the Forensic Medicine Department

The woman was examined one month later by the forensic physician. According to the medical report, she had compound fractures of the ulnar and radius bones of the left forearm with two skin tears at the posterior side of the left forearm, each 3 cm in length. The ulnar nerve was injured, causing weakness in the muscles of the left hand. Moreover, she had a dislocation of the joint between the right clavicle and the shoulder plate. The x-ray showed a comminuted fracture of the distal end of the ulnar and radius bones. The fracture was treated surgically. The woman stated that she was sitting in the passenger seat and was not wearing a seat belt. And she added that the car stood on its left side after turning over.

Examination of the car

The car was inspected by the forensic examiner and at examination time the car was moved from the scene of the accident to the Forensic Department at Dubai Police Headquarters. The car showed signs of collision at the front reaching the front windshield. The front windshield was cracked but was still in place. The rear of the car, including the rear windshield, also showed signs of collision (Figure 1).

Figure 1- *The 4 Wheel car with collision of the front and rear.*

The driver's seatbelt was in place and was not damaged. All side airbags were inflated and the airbag for the steering

wheel was inflated as well. The seats of the car were covered with a red synthetic material on top of the original leather seats.

Bloodstains found on the armrest of the driver's side as well as on the driver's seat were analyzed. On the armrest of the driver's seat, there were a few stains, which were circular in shape (Figure 2).

The red cover of the driver's seat was folded vertically forming a symmetrical bloodstain pattern with two faces on either side. The face on the right side had some bloodstains in the middle (Figure 3).

Results

The analysis of the bloodstains in the car resulted in defining their pattern, which showed that blood dripped

Figure 2- *Bloodstains on the handrest of the driver's seat.*

onto the driver's armrest from the passenger's side of the car was from a constant source, forming a flow pattern on the driver's seat. These results, coupled with a DNA analysis of the blood patterns, confirmed the woman's statement that she was sitting in the passenger seat and that the car stood on its left side after turning over.

Figure 3- *Bloodstains on the driver's seat.*

Analysis of the bloodstains in the car

Samples from the bloodstains on the driver's seat and the armrest on the driver's side were taken to the Forensic Biology laboratory and the DNA results for the bloodstains matched that of the woman. This raised the conflict regarding the woman's statement with respect to who was driving the car at the time of the accident. This led to examination of the car by a forensic pathologist, which is not a routine practice in such cases at the Forensic Department at Dubai Police.

Generally, bloodstains are analyzed according to their shape, size, and distribution. Blood, as a body fluid, obeys laws of physics like other fluids [1,4,13-15]. Both the bloodstain itself and the surface on which the blood has been deposited are important. The surface on which the bloodstain has been deposited has an effect on the bloodstain pattern it will form. Figure-4 shows the results of an experiment carried out by the author in which blood drops were deposited on different surfaces from a right angle at the same height and how the surface affected the pattern of the stain. The texture (rough or smooth) and porosity (porous or non-porous) of the surface on which the bloodstains are deposited are very important factors to be considered during the blood spatter analysis [2,10,14].

Many classifications have been used in interpreting bloodstain patterns, and one of them which has been developed by Tom Bevel and Ross Gardner is the division of bloodstains into two main categories: Spatter pattern and non-Spatter pattern. In a Spatter pattern, the blood moves with energy due to mechanical effect; while in a non-Spatter pattern, the blood moves passively due to the effect of gravity. Each category is subdivided into more patterns depending on further criteria observed in the stain [1,5,12,14].

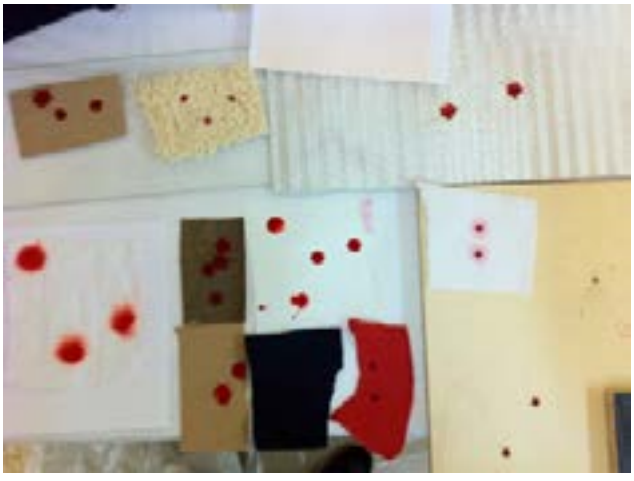

Figure 4- *The effect of the surface on the pattern of the bloodstains.*

In the case presented here, the blood deposited on the driver's seat was on synthetic absorbent surface, which absorbed the blood on it (Figure 3). Caution should be taken in such cases when interpreting and classifying bloodstain patterns on a synthetic absorbent surfaces [12,14]. The synthetic material on the seat had a vertical fold bulging outside and dividing the bloodstain on the cover into a pattern with two faces on either side; the face which was on the right side also had some bloodstains in the middle (Figure 3). The bloodstains were at the same level as the bloodstains on the armrest of the driver's side and exhibited an absorbed pattern. Some of the stains showed spines at the left side. The bloodstains stopped sharply at the margin of the vertical line and this could only have occurred if the blood source was from the right side. Some flow pattern was observed with directionality towards the left side, which also indicated that the source of the blood was from the right side of the seat. Moreover, the position of the source of the blood (deceased driver in this case), and the surface of the car seat on which the bloodstain depostited, did not change during the accedent. These observations supported the woman's statement.

The armrest of the driver's seat had a beige color leather cover. The bloodstains deposited on the armrest were circular in shape with a formation of symmetrical spines at the margins indicating that the blood source was perpendicular (Figure 2). The formation of satellites around the drops, which were more obvious at areas overlapping the drops, also indicates that the blood dripped from a perpendicular source for some time and that the source of blood dripped down onto the surface from above. This confirms the testimony of the woman that the overturned car came to rest on its left side. If the car had come to rest in an upright position, the blood stains deposited in the car would have exhibited a downwards directionality.

Satellites can form due to impact spatter patterns; however, in this case, the majority of satellites did not surround the circles. This was due to a second drop of blood dripping onto a blood pattern formed by an initial drop of blood. The resulting splash and increased blood volume in that area caused the satellites to form around the area of the overlap between the first blood drop and the second drop. Moreover, in this case, the bloodstains on the seat and on the armrest were lacking standard criteria-the distribution was not radial, as in an impact pattern, nor was it linear as in a cast off pattern. In addition, all the stains on the armrest and the seat were in a defined area and at the same level. This indicates that the source of bleeding for all of the blood stains on both positions was from the same source and from the right side [3,6,8,14,15].

Another important point taken into consideration was the possibility that the blood was deposited whilst the car was overturning, which means it was deposited in a moving space. This is a well-known phenomenon that if a car decelerates suddenly, the bodies in the car will continue to move [16]. In such cases, the part of the body which is the source of bleeding will also continue moving and will form a spatter pattern or a cast off pattern. In our case, the pattern was not a spatter pattern, and this also reinforces the statement that the blood was deposited whilst the car was resting on its left side. In addition, the source of bleeding was relatively stable as all the stains on the armrest of the driver's seat were beside each other in a defined area [15].

The analysis of the bloodstains enabled investigators to conclude that the woman's statement was correct. Taking the analysis of bloodstain patterns on the driver's seat into consideration, along with the injuries of the man, and the injury of the woman on her left forearm as the source of bleeding, these findings are in favor of the woman's statement that she was sitting in the passenger's seat and that the car came to rest on its left side [16].

Conclusion

This case emphasis the importance of bloodstain pattern analysis in crime scene reconstruction and in answering certain questions that could be raised by investigators. Whenever there is a bloodstain at any crime scene, it should be documented and investigated carefully for the purpose of identification and interpretation of the events associated with the incident. In road traffic accidents, the movement and the collision of the car, the nature of victims' injuries and blood spatter pattern are all factors that should be taken into consideration during forensic investigations.

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