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ORIGINAL ARTICLE

The Impression of Blood Droplets on Solid Surface and its Evaluation with Bloodstain Pattern Analysis, A Cross Section Forensic Study

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ABSTRACT

Task: The aims and objectives of current study were to identify the values of bloodstain pattern analysis for blood droplets on solid surface in forensic sciences.

Methodology:

Study design: Present study was conducted in different medical institutions of Lahore from November 2021to March 2022.

Crime scene (Blood droplets on solid surface): In current study for research purpose few blood droplets of 2 individuals were dropped on different solid surfaces and consider it as crime scene.

Sample collection: In this study total 10 blood samples were collected from different individuals for cross match with the droplets of blood sample collected from solid surfaces. 2, individuals how dropped their blood droplets on solid surfaces were also included in total participants of present study.

Blood droplets from solid surfaces were collected with the help of cotton swab techniques.

DNA analysis: With the application of Polymerase chain reaction such analysis performed and DNA released from the cell by extraction and measured the amount of genetic material than amplified its copies and separated these amplified copies from each other. The qualitatively and quantitatively comparing of DNA evidence samples are referred as DNA profiles and checking the technical correctness of analyst reports was its quality assurance.

Solution for blood stain identification: Luminol in the presence of H_2O_2 to combine with heme group of blood and created bright blue glow called chemiluminescence and with the help of such glow dried blood on surfaces can be detected.

Bio-statistical analysis: Raw data bio-statistically represented by the application of SPSS model 2020, regression of different parameters showed as mean standard deviation of significant ($P<0.05$) changes.

Results: DNA samples from blood droplets on solid surface (crime scene) and 10 other individuals (possible suspects) were processed. In present study for cross match analysis particular genetic marker i.e. two alleles or versions was considered which match the possible suspects DNA with the DNA from crime scene. The other has two copies of the repetition, whereas the first only has one (see the brown section below) the repetition is duplicated in the other, though whereas the second allele yields a 300 bp DNA fragment, the first allele yields a 200 bp DNA fragment. For 10, DNA samples perform PCR and Utilize gel electrophoresis technique for DNA matching. It has seen that two pair of alleles of sample A from crime scene DNA at 300bp (1.0±0.1) and 200 bp (1.2±0.4) have closed relation with the same DNA alleles of suspects-1 and two pair of alleles of sample B from crime scene DNA at 300bp (1.3±0.2) and 200 bp (1.5±0.1) showed resemblance with suspect-10 comparatively. The measured mean standard deviation levels of alleles similarities are significant ($P<0.05$) regarding standard measures.

Conclusion: Blood is an important source of information that, when properly understood, may be utilized as a source of information to support investigations. Thus, a correlation between the development of blood stains and height was established.

Keywords: Bloodstain pattern analyzers, crime scene, suspects, regression, blood droplets

INTRODUCTION

Bloodstain pattern analyzers can study the blood evidence left behind and make assumptions about the possible methods of blood loss. Analysts can classify bloodstains from what may appear to be a randomly distributed pattern at a crime scene by gathering information from spatter patterns, transfers, voids, and other signs that help investigators reconstruct the sequence of events that followed bloodshed [6]. When analyzing this type of physical evidence, the analyst must spot patterns and interpret them to ascertain how they were made. Bloodstain pattern analysis (BPA) is the investigation of bloodstains at a crime scene to reconstruct the events that resulted in the bloodshed. Analysts develop conclusions about what happened or did not happen based on the size, shape, distribution, and position of the bloodstains [9].

BPA helps researchers respond to inquiries like these by utilizing the concepts of biology (blood behavior), physics (cohesion, capillary action and velocity), and mathematics (geometry, distance, and angle) [8]. And to aid investigators in addressing issues like, what source did the blood have? What triggered the injuries? What angle did the victim's injuries come from? How were the perpetrator(s) and victim(s) situated? What actions were taken following the bloodshed? How many possible offenders were there? Does the bloodstain evidence confirm or deny the testimony of the witnesses? etc. [7]. A drop of blood put at a 90° angle takes on a nearly perfect spherical shape because blood exhibits surface tension, or cohesive forces that function as an outer skin.

This spherical-shaped drop will not deviate much from a smooth surface, such as tile or linoleum, but a rougher surface, such as carpet or concrete, disturbs the surface tension and causes the droplets to disintegrate [1]. The amount of pertinent information that may be acquired depends on the quantity and distribution of stains as well as the amount of blood. Large volumes of blood, such as if the victim died from bleeding to death or was seriously injured, might frequently provide less information than several distinct splatter patterns. Blood may hide splatter or obscure stain patterns if there is too much of it [3]. On the other hand, too little blood just one or two drops will probably produce scant or no useful information.

Cutting away stained surfaces or materials, taking photos of the stains, drying and packing damaged things are among methods for gathering bloodstain samples for BPA testing. High-quality cameras (still and video), drawing supplies, cutting equipment, and evidence packing are typically used for gathering bloodstain evidence [2]. High-resolution photography is the technique that is most commonly used to record bloodstains. In order to measure the bloodstain accurately, a scale or ruler is set next to it, and pictures are shot from all angles. In order to identify if it is human blood and subsequently create a DNA profile, analysts or investigators frequently soak up pooled blood or swab tiny quantities of dried blood. Two DNA profiles being found at a scene when there is only one known victim may indicate that the attacker was injured during the crime [5]. Bloodstain pattern analyzers are increasingly more likely to hold degrees in mathematics or a physical science, such as physics, chemistry and biology.

Bloodstain analysts employ well-established scientific techniques, such as information collecting, observation, documentation, analysis, assessment, conclusion, and technical review, to evaluate bloodstain evidence at a crime scene [11]. To ensure accuracy and quality, all tests and experiments should be able to be replicated by unaffiliated experts. Depending on whether the region has any skilled analysts, outside consultants are usually utilized. The intricacy of the case and whether or not additional knowledge beyond that of the local analyst is necessary will also influence where the analysis will be conducted. The physical features of stain patterns, such as size, shape, distribution, overall appearance, position, and surface roughness, are examined using pattern analysis [13]. Analysts decipher the sorts of patterns that are there and the potential factors that led to them. Reconstruction used analytical data to provide context for the stain pattern explanations.

MATERIALS AND METHODS

Aims and objectives: The aims and objectives of current study were to identify the values of bloodstain pattern analysis for blood droplets on solid surface in forensic sciences.
Crime scene (Blood droplets on solid surface): In current study for research purpose few blood droplets of 2 individuals were dropped on different solid surfaces and consider it as crime scene.
Sample collection: In this study total 10 blood samples were collected from different individuals for cross match with the droplets of blood sample collected from solid surfaces. 2, individuals how dropped their blood droplets on solid surfaces were also included in total participants of present study.
Blood droplets from solid surfaces were collected with the help of cotton swab techniques.
DNA analysis: With the application of Polymerase chain reaction such analysis performed and DNA released from the cell by extraction and measured the amount of genetic material than amplified its copies and separated these amplified copies from each other. The qualitatively and quantitatively comparing of DNA evidence samples are referred as DNA profiles and checking the technical correctness of analyst reports was its quality assurance.
Solution for blood stain identification: Luminol in the presence of H_2O_2 to combine with heme group of blood and created bright blue glow called chemiluminescence and with the help of such glow dried blood on surfaces can be detected.
Bio-statistical analysis: Raw data bio-statistically represented by the application of SPSS model 2020, regression of different parameters showed as mean standard deviation of significant (P<0.05) changes.

RESULTS

Initially two different samples of Blood droplets were collected from solid surfaces (crime scene) while 10 blood samples were taken from different individuals (suspected individuals) for cross match with blood droplets from crime scene, through bloodstain pattern analysis. Correlation between two samples with suspects were performed through Polymerase chain reaction for DNA qualitatively and quantitatively profiling.

DNA samples from blood droplets on solid surface (crime scene) and 10 other individuals (possible suspects) were processed. In present study for cross match analysis particular genetic marker i.e. two alleles or versions was considered which match the possible suspects DNA with the DNA from crime scene. The other has two copies of the repetition, whereas the first only has one (see the brown section below) the repetition is duplicated in the other, though whereas the second allele yields a 300 bp DNA fragment, the first allele yields a 200 bp DNA fragment

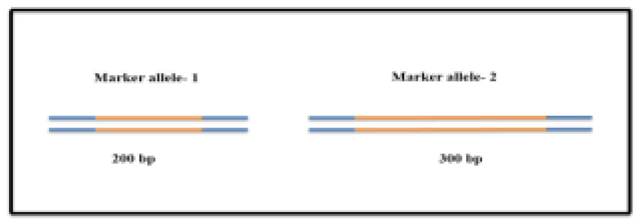

Fig-1:

For 10, DNA samples perform PCR and Utilize gel electrophoresis to see the findings were showed below.

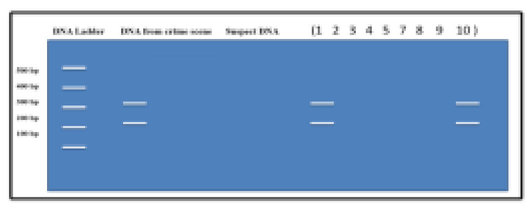

Fig-2:

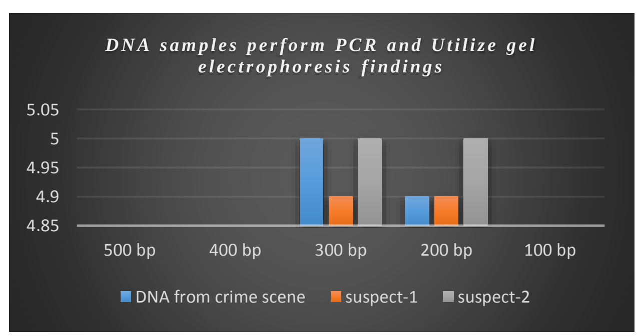

Fig-3:

Table 1:

DNA ladder	DNA from crime scene		Suspects DNA (Mean± SD)									
	Sample A	Sample B	1	2	3	4	5	6	7	8	9	10
500 bp												
400 bp												
300 bp	1.0±0.1	1.3±0.2	1.0±0.1									1.3±0.2
200 bp	1.2±0.4	1.5±0.1	1.2±0.4									1.5±0.1
100 bp												

(P<0.05)

It has seen that two pair of alleles of sample A from crime scene DNA at 300bp (1.0±0.1) and 200 bp (1.2±0.4) have closed relation with the same DNA alleles of suspects-1 and two pair of alleles of sample B from crime scene DNA at 300bp (1.3±0.2) and 200 bp (1.5±0.1) showed resemblance with suspect-10 comparatively. The measured mean standard deviation levels of alleles similarities are significant (P<0.05) regarding standard measures.

DISCUSSION

Karger B, R and SP, Brinkmann (2010) stated in their study that the most important evidence discovered at a crime scene was bloodstain pattern analysis (BPA), from which many conclusions may be made. Using electrophoretic and immunological techniques, forensic scientists assessed bloodstains by seeing DNA or determining the blood type. BPA was a set of forensic techniques developed after looking at bloodstains found at a crime scene with the intention of changing the behaviors crucial to these bloodstains. The idea was to determine the cause of the bloodstain, which is usually referred to as the bloodletting episode. BPA's primary goal was to determine the relationship between a single blood droplet and an emerging [2]. If blood drops from a bloodletting episode were believed to be responsible for a certain blood stain, their paths may converge when discovered after the stain, and the location of their meeting is believed to provide an accurate indication of where the bloodletting incident took place [15].

Vital evidence is rottenly grown by a thorough understanding of bloodstain patterns at crime scenes. Blood shedding reform can be supported by the dispersion, size, and kind of bloodstains on an item, a suspected person, on walls, floors, ceilings, or on objects in plain view. Bloodstain pattern studies can also be used to assess the veracity of statements made by an observer, a target, or a suspect [10]. BPA was the investigation of techniques as well as the positioning and sprinkling of bloodstain projects in order to explain the physical actions of a crime that contributed to its growth. When studied by a trained expert, the bloodstain patterns might provide crucial evidence of the events that led to their creation. The utilization of these scientific tools, physical indicators, common perceptions, and their interactions were the primary assurances to get at clear knowledge of the sequence of events that precede the commission of a crime [14].

In current study eleven potential sites of origin were found for all the bloodstains that were investigated. It was discovered that the width of the blood stain increases as the surface area of the tool's tip, where the blood droplets fall, rises, and vice versa.

Additionally, it was observed that, assuming the height in each case was the same, an increase in stain diameter led to an increase in blood drop volume. Thus, it was determined that the volume of blood droplets is dependent on the surface area of the source item; the larger the origin's surface area, the higher the blood drop volume. In this study DNA samples from blood droplets on solid surface (crime scene) and 10 other individuals (possible suspects) were processed. In present study for cross match analysis particular genetic marker i.e. two alleles or versions was considered which match the possible suspects DNA with the DNA from crime scene. The other has two copies of the repetition, whereas the first only has one (see the brown section below) the repetition is duplicated in the other, though whereas the second allele yields a 300 bp DNA fragment, the first allele yields a 20 bp DNA fragment. The measured mean standard deviation levels of alleles similarities are significant ($P<0.05$) regarding standard measures.

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