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## Review Article

## Blood &amp; blood stains in criminal investigation: A forensic perspective

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## ABSTRACT

Frequently blood and blood stains are encountered at the crime scene places. The blood stains may be found in different patterns and the analysis of these different patterns helps in the establishment of the crime especially in homicide cases or other violent crimes. In certain cases, this may help in the establishment of the identity of an unknown accused or victim. The analysis of blood stains may also help in the detection of certain poisonous substances. The present article is a review type and it is observed that a meticulous examination considering the size, shape, distribution, overall appearance, and location of the blood stains will be very helpful in the crime scene investigation.

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## 1. Introduction

Blood is biological evidence that is often found at the crime scene.<sup>1</sup> It is frequently seen in crimes such as homicides, suicides, assaults, hit-and-run cases, burglary, rape, and other sexual offenses.<sup>2,3</sup> Different compositions of blood such as red blood cells, white blood cells, platelets, and other proteins may also be used in various studies including the study of DNA patterns and paternity tests. It is also useful in crimes related to criminal abortions and delivery. In certain poisoning cases, the cause of death may be established from the chemical analysis of the blood.<sup>4,5</sup> Time since death may be estimated from the biochemical and enzyme changes in the blood. However, we must take care because false criminal charges may be brought by using animals or other blood-like substances.

Whenever an examination of blood and blood stains is conducted we need to consider the following points:-

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1. *Are They Really Blood or Not:* Some stains of substances like rust, dyes, vegetables & fruit stains, etc. Very old stains of blood may be confused with grease, resin or tar stains, etc. In cases of rust stains, there will be no glaze appearance and stiffness of the cloth. If the rust stain is on the metal surface, there will be no scale formation when heated on the opposite side. Rust stains are soluble in hydrochloric acid. Synthetic stains turn yellow when nitric acid is added but they regain their original colour when treated with strong alkali. In cases of vegetables and fruits, microscopic examination will reveal the presence of plant cells and it becomes black when a drop of ferric chloride is added as it contains tannin. Confirmation may be done by doing the Haemin crystal test, Haemochromogen Crystal test, Spectrophotometry examination, and Electrophoresis test. Origin confirmation can be done by doing a precipitin test.<sup>6,7</sup>
2. *Living or Dead Body:* Blood effused during life can be collected in scales on drying as it contains fibrin. Post-mortem blood clots will not form scales and tend to break into powder.<sup>6</sup>

3. *From Which Part of Body:* (1) Bleeding from nose:- mucus & hairs from nostril commonly seen. (2) Menstrual bleeding:- Acidic, dark red with a disagreeable smell. Endometrial & vaginal epithelial cells. May contain Trichomonas vaginalis or monilia. (3) Blood from vomiting:- Chocolate brown & acidic reaction. (4) Blood from hemoptysis:- Frothy, bright red & alkaline.
4. *Artery or Vein:* Bleeding will be in spurts in cases of arteries & in jets Bleeding will be a continuous oozing type in veins. In most cases both artery & vein are involved together.
5. *Sex of The Person:* It can be determined from the presence of sex chromatin in blood cells.<sup>8</sup>
6. *Age of Person:* The Presence of Fetal Hemoglobin indicates that blood is from an infant or young child. The formation of thinner & softer coagulum indicates that blood is from an infant or young child.
7. *Ante-mortem or Post-mortem:* Ante-mortem fresh blood stains are red and they can be removed in scales due to the presence of fibrins. Post-mortem stains will crumble when manipulated for removal.

When some amount of blood is deposited on a surface it forms a blood stain and it may be a wet or dry stain. A larger blood collection resulting from an accumulation of liquid blood on a surface is known as a pool of blood.

Blood stains may be of the following types:-<sup>6-8</sup>

1. *Passive stains:-* It include drops, flows and pools, and typically result from gravity acting on an injured body.
2. *Transfer stains:-* It results from objects coming into contact with existing bloodstains and leaving wipes, swipes or pattern transfers behind such as a bloody shoe print or a smear from a body being dragged. This may be a swipe/Smear Type or Wipe/Smudge Type.
3. *Wipe/Smudge Type:* It results from blood projecting through the air and are usually seen as spatter, but may also include gushes, splashes and arterial spurts.

The height of the blood drop fall may also be determined by examining various factors. The higher the drop, the bigger the velocity and the larger the diameter. Circular, smooth with no projection means fall is less than 30cm & at 90°. Shape changes depending on the angle of impact, velocity, distance traveled and type of surface impacted. The angle of blood on a flat surface can be determined by measuring the degree of circular distortion. At right angles blood drop is circular, as the angle decreases, the stain becomes elongated.

The velocity of the blood drop may be divided into:<sup>9-11</sup>

1. *Low-Velocity Spatter:* Pattern consists of large separate or compounded drops with diameters of 3 mm or more, produced by minimal force, and hits the surface with less than 5 ft/s velocity as seen such as dripping from a wound.

2. *Medium Velocity Blood Splatters:* Consists of small drops with diameters of 1 -3 mm. They travel at an average of 5 to 25 ft/s. They are commonly associated with blunt force trauma.
3. *High Velocity Blood Splatters:* Consists of drops with diameters of less than 1 mm. This blood spatter hits at more than 100 ft/s as seen in gunshot spray.

## 2. Collection of Blood Sample:<sup>12-14</sup>

1. *For Liquid Blood:* It may be collected by using white filter paper, white gauze, or a white sterile cotton cloth. Air dry at room temperature & keep in a paper bag or box after sealing.
2. *From Clothing:* Note the type, colour, consistency, and size of the cloth. Note the size, shape & position of all stains. Air dry and keep with minimum possible folds. Air dry at room temperature & keep into a paper bag or box after sealing.
3. *From Non-porous Surface:* Scrap the dry stain with the blade of a knife and preserve it in glass container.
4. *From Porous Surface:* Cut that area & air dry at room temperature the preserve it.
5. *From Body Surface:* If wet then use a dry swab to soak in. If dry, then rub with a swab soaked with normal saline. Air dry at room temperature & preserve it. Any blood stains must not be preserved in polythene bags or air-tight containers.

## 3. Documentation of Blood Stains

Documentation of the details of bloodstains is very important step. This will ensure proper interpretation and preservation of the valuable evidence. Photography is one of the simplest methods for documentation of blood stains at the crime scene especially it is not easily accessible.<sup>15</sup> Now more sophisticated equipment such as 3D Laser Scanners are available which can scan the whole blood stained area of the crime scene area.<sup>16</sup> By using different advanced software these images may be converted into a virtual 3 D models and then detail analysis can be done.<sup>17</sup>

## 4. Information from Blood Stain

Many useful information can be obtained from the analysis of blood stains found at the crime scene. From the forensic angle, information such as position of the individual i.e. whether the person was in sitting or standing position, relative position of the victim and accused, and possible type of the weapon may be established.<sup>1,2</sup> Such many useful information collection is possible from the analysis of various patterns such as splashed & dripped patterns, impacted patterns, projected patterns, cast off stains, expired and transferred patterns.<sup>18</sup> By determining approximate age of the blood stain we may establish approximate time of when the injury was inflicted. Several

methods have been tested for estimation of age of blood stains.<sup>2,19</sup>

## 5. Conclusion

Blood stains are very useful biological evidence in the crime scene investigation. Blood stains on the cloth of a victim may be matched with the blood stains discovered on a suspected accused in an assault or murder case. Sometimes false allegations may also happen by using blood-like substances such as synthetic or organic dyes. The blood stain analysis may also help in the establishment of the identity of the accused or victim. It may also help in the chemical analysis for the detection of toxic substances.

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## 7. Conflict Interest

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